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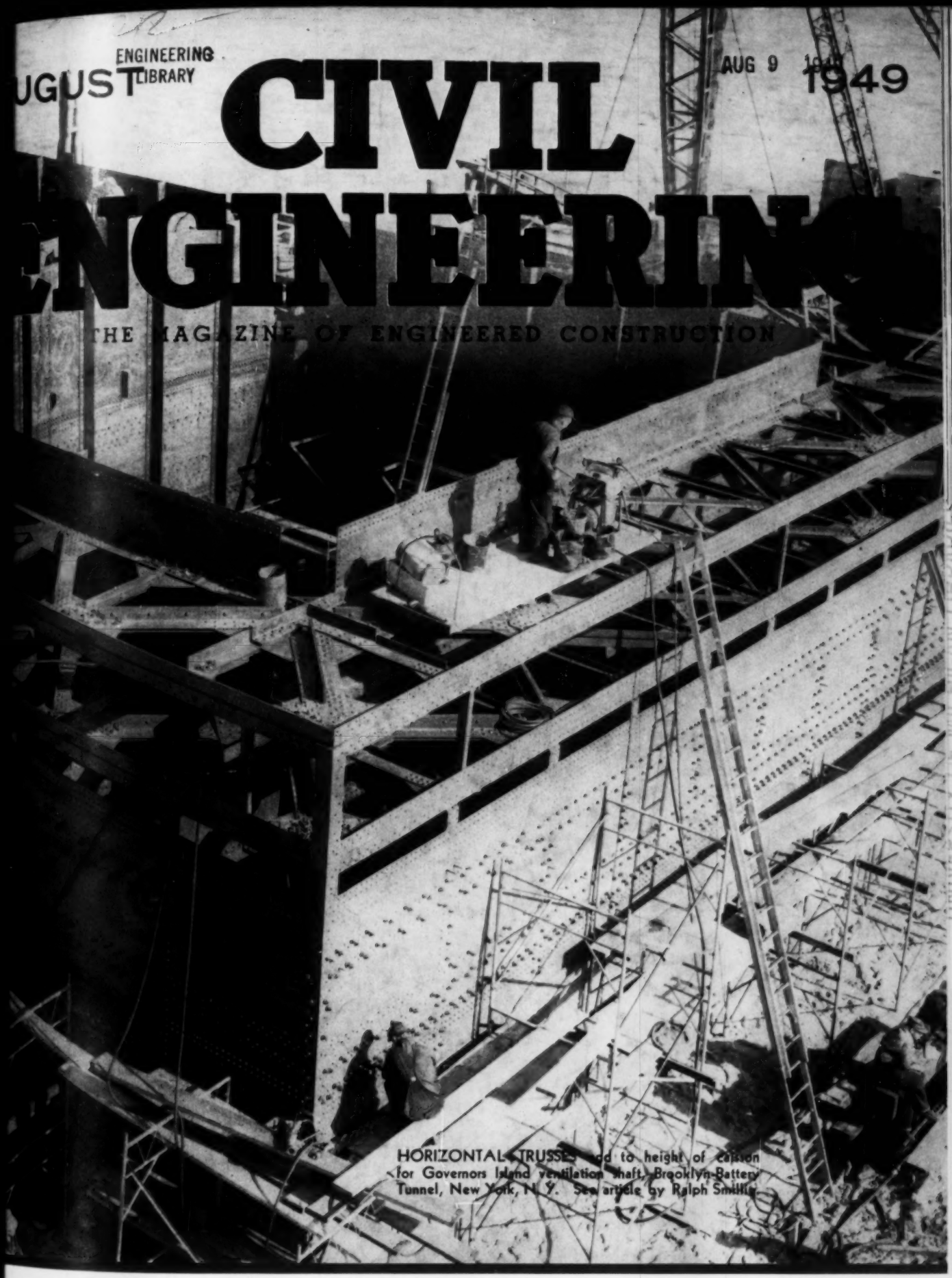

HORIZONTAL TRUSSES lowered to height of caisson for Governors Island ventilation shaft, Brooklyn-Battery Tunnel, New York, N. Y. See article by Ralph Smillie

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Mexico City Buildings Supported on Compressible Clay—Albin

How Many and What Kind of Engineering Graduates Are Needed?
—Molineaux, Case, Wallace, Boelter

Mexico Builds Irrigation Dams to Suit Local Conditions—Orozco

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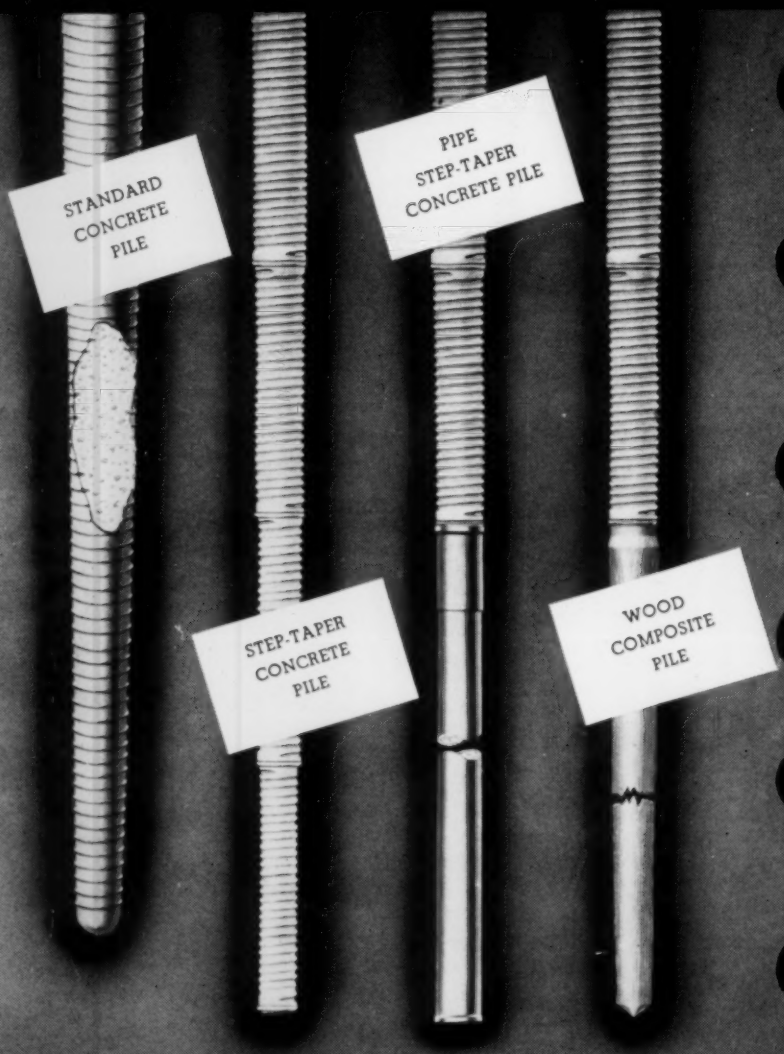

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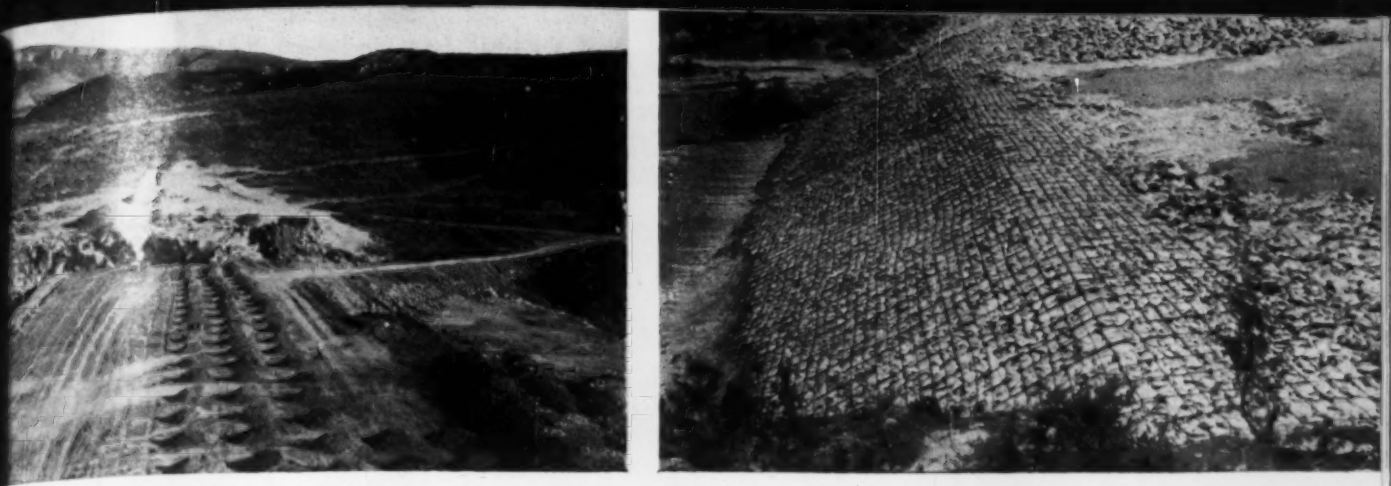

TYPICAL OF SMALL DAM construction in Mexico is Cuarenta Dam, 164 ft high containing 844,000 cu yd of earth and rock, now under construction. Work proceeds simultaneously on impervious, semi-pervious and rockfill zones (above left). Light trucks haul earth and rock. Excavation for concrete cutoff in left abutment proceeds in distance. Before closure, downstream rockfill slope was protected by mesh of reinforcing bars (above right). Mesh is anchored to rock fill mass and to concrete slab in bottom of river bed. No diversion tunnel was provided. This method of passing flood water over earth dams is safe and economic when right conditions exist and proper precautions have been taken. Method has been used successfully on several dams in Mexico.

Mexico Builds Irrigation Dams to Suit Local Conditions

J. VICENTE OROZCO, Assoc. M. ASCE

Chief Engineer of Irrigation, Ministry of Hydraulic Resources, Mexico City

THREE MAIN FACTORS are considered responsible for the preponderance of the earth and rockfill type of dam in Mexico. First, as might be expected in a land of many volcanoes, most damsites are crossed by fissures, fractures and fault systems. Second, rivers are relatively short, and possible reservoir sites are mostly in the foothills, where very long dams are required. Third, economic considerations favor the earth or rockfill type, which makes maximum use of local materials and demands less skilled labor. Also, cement is scarce and expensive, and the transportation of it and of equipment presents difficulties. These and other considerations governing the design and construction of dams in Mexico are explained by Mr. Orozco in this article, based on the paper he presented before the Irrigation Division at the Society's Mexico City Convention.

OF THE FORTY-THREE DAMS more than 50 ft high which have been constructed by the Mexican Government to store water for irrigation since 1926, eighteen are now under construction, an indication of the present interest in increasing the agricultural production of the country. Of these 18 structures, 15 are of earth or earth and rockfill, types which predominate in Mexico because they have been found most economical for the majority of sites.

Without interruption since 1926, when the Mexican Congress passed a reclamation law modeled after the United States Reclamation Act of 1902, the Mexican Government has followed the policy of encouraging irrigation by building dams and appurtenant works. Up to 1946 the execution of this development program was entrusted to the National Irrigation Commission, a federal bureau. In January 1947 the Commission became the Ministry of Hydraulic Resources and its staff was transferred practically intact, and somewhat enlarged, to the new Ministry.

As has been mentioned, in the past 23 years, 43 storage dams more than 50 ft in height have been built or are under construction. Their combined storage capacity will be 10,850,000 acre-ft. Two dams have a storage capcity of 2,432,000 acre-ft each. The water stored by all 43 dams will irrigate a total of 1,827,000 acres. At six of the dams it is planned to generate power, the yearly expected total being 387,000,000 kwhr.

Twenty-seven of these 43 dams are of the earth or earth and rockfill type. The highest dam in this category is Lazaro Cardenas (El Palmito), an earth structure with a height of 302 ft, a volume of nearly 7 million cu yd, and a storage capacity of 2,432,000 acre-ft (Fig. 1). The largest earth dam, in point of volume, is Alvaro Obregon (Oviachic), which is 187 ft high and contains 11,144,000 cu yd of material (Fig. 2). Like Lazaro Cardenas, its storage capacity is 2,432,000 acre-ft, providing for the irrigation of about 519,000 acres. This dam is still under construction and completion is planned for the spring of 1952.

Of the four dams which are entirely of rockfill, the highest is San Ildefonso, 203 ft high, having a volume of 484,000 cu yd and a maximum storage capacity of 42,000 acre-ft.

Two dams of the 43 referred to above are of rockfill with an impervious consolidated earthfill at the upstream side. The Requena is the largest of these, with a maximum height of 125 ft and a storage capacity of 57,000 acre-ft.

The remaining ten dams are of masonry or concrete of various types. In this category, five are gravity type, none of them very high. The highest is La Cuña, 79 ft high, containing 26,000 cu yd, and capable of storing 4,000 acre-ft. Slightly larger in volume is Valle de Juarez, 66 ft high, containing 27,000 cu yd and with a storage capacity of about 15,000 acre-ft. Both these gravity-type dams are under construction.

One other concrete dam is now under construction, Francisco I. Madero (Las Virgenes), a round-head buttress type 157 ft high, containing 133,000 cu yd and capable when completed of storing about 328,000 acre-ft for irrigation and power. Power-generating equipment will be installed at this dam and the yearly probable production of electrical energy is 26,000,000 kwhr. Completion is scheduled for the winter of 1949.

The four other concrete dams are in operation. See Table I.

One of these dams has power generating facilities, La Angostura, and will produce 33,000,000 kwhr yearly.

A combination of several factors is responsible for the predominance

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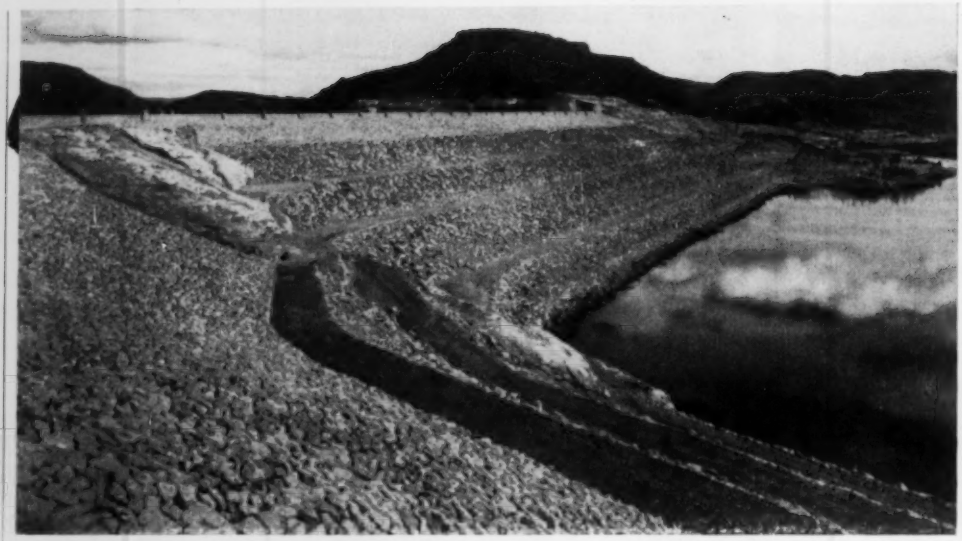


WITH VOLUME of 7,000,000 cu yd of earth, gravel and rock (see Fig. 1 below) Lazaro Cardenas Dam is highest in Mexico (302 ft). Stepped upstream slope (above, left) is faced with riprap. In construction, borrow pit material was loaded by shovel into dump trucks (top, right) for placing in impervious earth zone (lower right) where it was spread by bulldozer and rolled by tractor-drawn sheepsfoot. Concrete cutoff trench in river-bed section (left) was later raised into earthfill.

of the earth dam in Mexico. The chief factors are:

1. Geological conditions are conditioned by the volcanic nature of the area. A great part of the surface is formed by igneous rocks, mainly of the extrusive type, such as basalts, ryolites and andesites. These rocks have been subjected to severe movement of the earth's crust with the result that they are fissured and crossed with fractures and fault systems. Even where the rock is of the intrusive type, such as granite, or of sedimentary origin, as limestone, foundation conditions are generally unfavorable. Very often where it would appear that a sound rock foundation is available (from the geologic point of view) more thorough investigation reveals that practical considerations make the site unsuitable for a concrete or masonry dam; that is, the amount of work necessary to provide the proper foundation is so expensive that the concrete type of structure cannot compete with the earthfill type, the foundation requirements for which are less rigorous.

Damsites which are well adapted to the construction of concrete arch dams are truly exceptional in Mexico. The same is true, although to a lesser degree, of other types of concrete dams, such as gravity, round-head buttress, and multiple arch. However, Mexican engineers are always alert to the possibility of using other types of dams besides the earth and rockfill when geological conditions are sufficiently favorable to make them economically feasible.

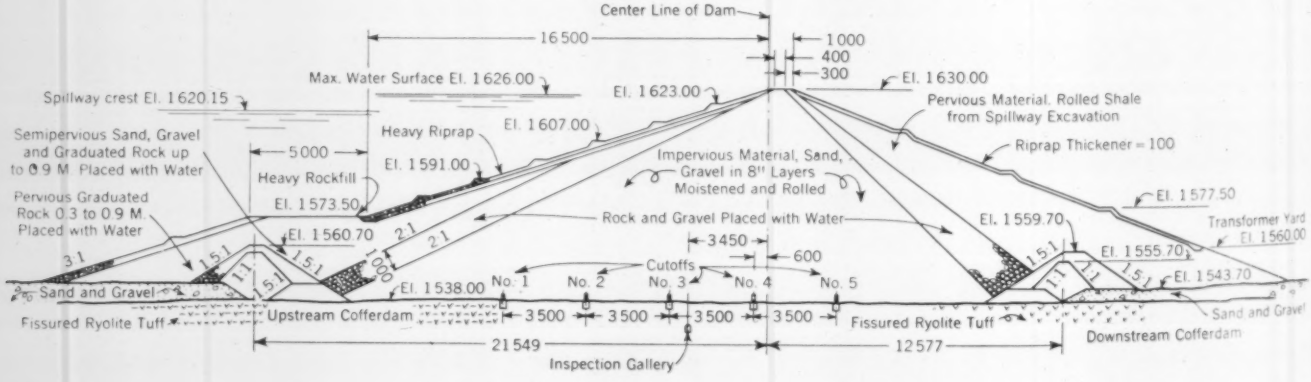
2. Rivers are relatively short and drop in a few hundred miles from their point of origin in the mountains down to the coastal plain or to the broad valleys in the altiplain. The coastal plain is generally not very wide.

In the mountains, as is to be expected, the river courses are generally narrow and steep. Therefore the dams would have excessive heights in relation to the amounts of water that could be impounded. After leaving the mountains the rivers generally pass through a transitional hilly zone before they reach the coastal plain or interior valleys. It is in this transitional zone that the best reservoir sities are usually found, with good storage capacities and

TABLE I. CONCRETE DAMS IN OPERATION IN MEXICO

Dam	Type	Height Ft	Volume Cu Yd	Storage Capacity Acre-Ft
La Angostura	Concrete arch	298	190,000	681,000
Calles	Concrete arch, gravity	207	60,000	276,000
Rodriguez	Ambursen	187	87,000	111,000
Jocoqui	Multiple arch	138	31,000	8,000

FIG. 1. HIGHEST DAM in Mexico is Lazaro Cardenas (El Palmito) in State of Durango. Powerhouse will generate 145,000,000 kwhr.



TRUCK DUMPS rockfill (above, left) for upstream zone of Alvaro Obregon Dam, while water is applied at 1.1 ratio, by volume to wash in fines and consolidate material (see Fig. 2, below). Cleaned rock bottom of cutoff excavation (above, right) extends longitudinally 2,000 ft for width of 65 ft and depth of 104 ft below river bed. Longitudinal drain in foreground handles seepage, which to date has not exceeded 42 cfs. Grout curtain has been completed by grouting unit mounted on truck trailer (right).

dams of moderate height. The largest reservoirs in Mexico are located in this zone, for example, the Alvaro Obregon Dam in Sonora and Lazaro Cardenas Dam in Durango. The difficulty is that in this zone the damsites are wide, requiring long dams to close them, frequently around a mile. The length of the dams, combined with generally poor geological conditions for foundations, results in the choice of the earthfill type in most cases, as this type is the cheapest and best adapted to the rock formations obtaining.

On the plains, damsites are often too wide and the deposits of sand and gravel overlying bedrock reach considerable depths. These conditions generally would permit only relatively small reservoirs and low dams, making the cost of impounding water very high per acre-foot. Also, dams would have to have very flat slopes and wide, impervious blankets.

Why Concrete Dams Are Expensive

3. Unit prices prevailing in Mexico for dam construction at present are such that the earth type, either of graduated materials or of earth and rockfill, is more economical than concrete or stone masonry. This is merely a statement of the general situation, as of course damsites do exist that have favorable geological, topographical and economic conditions for the construction of concrete dams. Such dams have been built at several sites, as previously described.

The relatively high cost of concrete dams in Mexico is due to several factors. The country has few cement mills, relatively few good roads and in general not very efficient transportation facilities. Therefore freight costs are high and delivery of materials uncertain, making it difficult to maintain a construction schedule. Construction lumber is becoming very scarce and expensive, and finally, labor also contributes to the high unit price of concrete work. Although wages are much lower than in the United States, the average output is also lower.

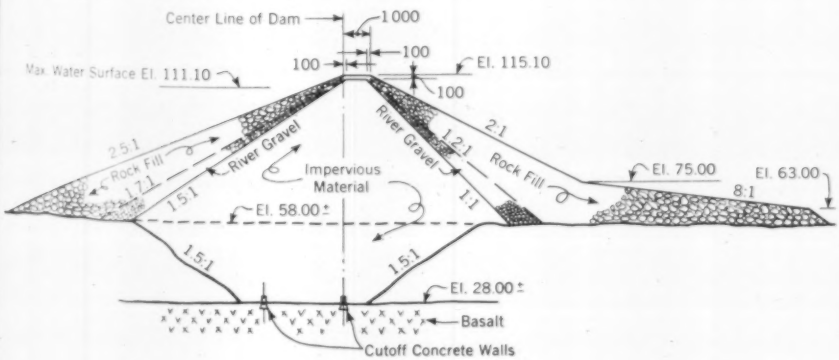
Another consideration is that concrete dam types require more specialized knowledge and a higher standard of workmanship on the part of contracting organizations, which in Mexico are generally more familiar with earthwork construction.

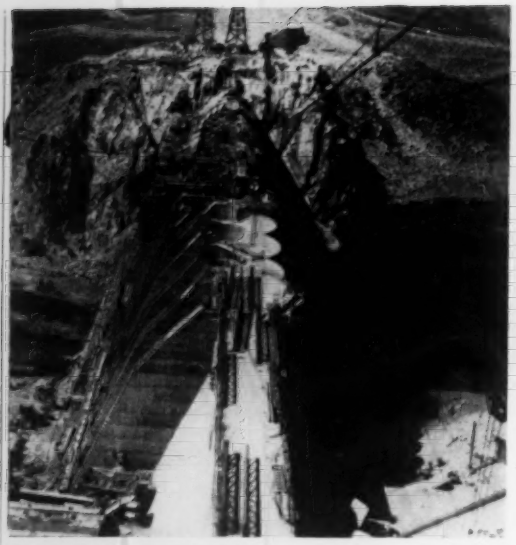
In general the earth dams built in Mexico have a simple cross section, consisting of a central trapezoidal core of impervious material on a slope of 0.5:1, 1.25:1 or 1:1, stabilized with heavy rockfill outside zones, usually on a slope of 2.25:1 on the upstream side and 2:1 on the downstream side, depending on the materials available. Usually there is a thin intermediate zone of water-placed rock and river gravel or river gravel alone. Except for the wave-action protection on the upstream face, the material for the rockfill zones need not necessarily be quarry rock. Any good, coarse, heavy material is acceptable, such as conglomerate, gravel, or weathered rock, so long as it fulfills the basic requirement of forming a pervious and free-draining fill having the minimum unit weight required by the stability analysis.

Recently a few earth dams of the graduated materials type have been built in Mexico, the largest being the Marte R. Gomez (El Azucar) Dam (Fig. 3) completed in 1943. This dam, on the San Juan River in the State of Tamaulipas, is 3.7 miles long and 135 ft high, has a volume of 6,213,000 cu yd and a storage capacity of 811,000 acre-ft, and provides for the irrigation of 148,260 acres.

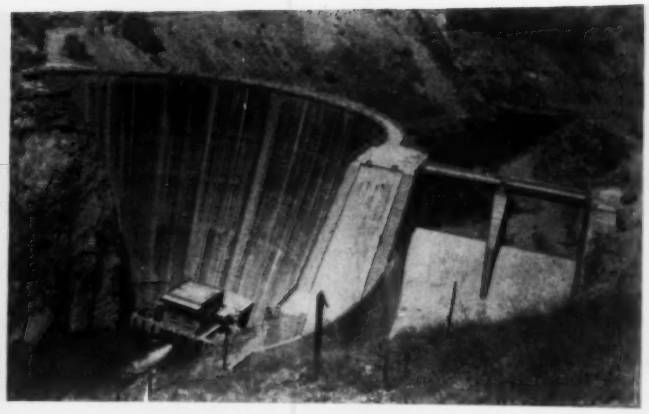
The reason why more dams are not built of the graduated materials type is economic. At present unit prices of material in place in the dam, the ratio of cost of rockfill (quarry rock) to rolled impervious earth is from 1.8:1 to 2.0:1. Another economic factor operating against the choice of the graduated materials type is the greater volume of material it requires because of the flatter slopes. However, this type might have offsetting advantages, as for instance, where geological conditions

Fig. 2. ALVARO OBREGON DAM, now under construction in State of Sonora, has largest volume of Mexican dams, containing 11,144,000 cu yd of impervious earthfill, river gravel and rockfill. Power generating equipment, to be installed, will add 125,000,000 kwhr to country's hydro capacity.





MOST DAMSITES in Mexico call for earth and rockfill structures but some are suited to concrete dams. Francisco I. Madero Dam, now completed and in operation, is round-head buttress type 157-ft high containing 133,000 cu yd and storing 328,000 acre-ft for irrigation of 74,130 acres in State of Chihuahua.



HIGHEST CONCRETE DAM in Mexico is Angostura (298 ft) on Bavispe River, State of Sonora. Arch-type structure contains 190,000 cu yd of concrete and future powerplant will generate 33,000,000 kwhr yearly.

require the longest possible percolation path. Under such conditions the graduated materials type would probably be adopted in order to provide an impervious zone with a wider base.

This was the case at the site of the Marte R. Gomez Dam previously mentioned. Here the foundation material consists of lucites, shales and marl under part of the dam and of partially consolidated sand-clay-loam in the flood plain, requiring the design shown in Fig. 3, with a very wide base, flat outside slopes and zones made up of graduated materials locally available.

With the decreasing value of pesos in terms of dollars, the unit price of rockfill may be expected to rise up to three times that of rolled earthfill. If this happens, then the designer of dams in Mexico will doubtless find the graduated materials type of dam cheaper than the earth and rockfill type.

In Mexico as elsewhere it is necessary for maximum economy to utilize local materials to the utmost and in the simplest possible way. For example, good impervious fills for dams have been secured by using a wide variety of materials, such as gravels, taluses and weathered rocks, all with enough clay and other fines to secure good structural properties when consolidated with smooth road rollers. For Sanalona Dam, a 213-ft-high structure containing 6,357,000 cu yd, advantage was taken of the presence nearby of decomposed granite. In Valsequilla Dam, 269 ft high and containing 968,000 cu yd, weathered calcareous conglomerate was utilized because it was locally available. In both these dams, tractor-drawn smooth rollers were used for consolidation because of the coarseness of the material. Lumps more than 10 in. in size were crushed or pushed into the fill by these rollers.

For making the necessary soil tests to secure safety and economy in the design of earth dams, the facilities of the Soil Mechanics Laboratory of the Ministry of Hydraulic Resourses are utilized. The laboratory is staffed with specialists in this field. Advantage is also taken of developments in other countries, especially the United States, our good neighbor.

Economic Considerations in Dam Construction Are Paramount

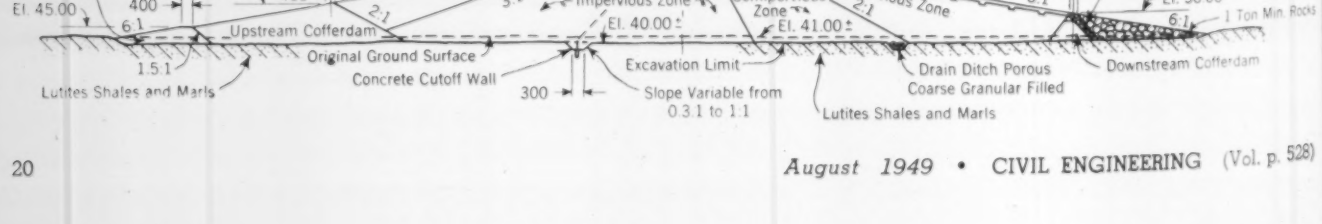
One of Mexico's most pressing needs is increased agricultural production. In spite of limited financial resources the government has been allotting as large a sum as possible each year for the construction of irrigation projects all over the country. Dams form an important part of such projects, and in their design and construction, economic considerations are paramount.

Simplicity of design is essential for economy. This means the maximum use of materials available at the job site and the minimum use of imported materials and equipment. Elaborate mechanical installations such as for spillway crests, outlets and sluice works, must be avoided if possible. Practically all such installations together with large steel penstocks, steel tubing, valves and gates for dams and appurtenant works as well as almost all construction equipment, come from the United States.

Another consideration that cannot be overlooked by the engineer engaged in construction work in Mexico is the time required to get equipment to the job site. Manufacturers' delivery dates (often far in the future), long negotiations over export and import permits, transportation difficulties and finally the long distances between United States factories and the job sites, all cause uncertainty and delay for which allowance must be made in construction schedules.

For help in the preparation of this article, the writer wishes to acknowledge his indebtedness to the following engineers connected with the Ministry of Hydraulic Resources: Andrew Weiss, Hon. M. ASCE, head of the Consulting Department; Max W. King, Consulting Engineer; Aurelio Benassini, Assoc. M. ASCE, Assistant Chief Engineer, Irrigation Division; Oscar Vega Argüelles, Director of Design; and Augusto de Yta, Construction Director.

FIG. 3. GRADUATED MATERIALS TYPE of construction is exemplified by Marte R. Gomez (El Azucar) Dam. Length is 3.7 miles, height 151 ft, volume 6,231,000 cu yd, reservoir storage capacity 811,000 acre-ft, and irrigable area 148,260 acres. No power is generated.



How Many and What Kind of Engineering Graduates Are Needed?

WHAT KIND of knowledge and ability is expected of engineering graduates? In his paper, here summarized, Mr. Molineaux supplies answers based on recent comments received from a wide cross section of the civil engineering profession in response to a questionnaire which he prepared and sent out. He concludes that a broad basic training in college is a prime need, followed by a program of in-service training and postgraduate study.

Mr. Molineaux's paper was one of two presented before the Engineering Education session at the Society's Mexico City Convention. This session, sponsored by the ASCE Committee on Engineering Education, was led by William J. Armento, chairman of the committee.

What is the relation between the supply and the demand for engineering graduates? This question was considered in the other paper delivered at the Engineering Education session, that by Messrs. Boelter, Case, and Wallace, which also is summarized on succeeding pages. The authors state that the technological advance of our nation is associated with the number entering the engineering profession. One of the important responsibilities of the profession will be met by training an adequate number of men to meet any abnormal demand that may arise. Challenging the findings and conclusions of agencies that have forecast the supply and demand variously from a large deficit of graduates to a fairly large surplus for the next few years, the paper proposes a forecast of trends in engineering manpower based on national economic indexes. Changing economic conditions, the authors feel, could quickly change the balance from a surplus to a deficit.

William J. Armento, Chairman, Committee on Engineering Education; Lecturer, College of City of New York, N.Y.

In-Service Training Urged

To Supplement Formal Engineering Education

CHARLES B. MOLINEAUX, M. ASCE
Chief Engineer, Arthur A. Johnson Corp., New York, N.Y.

A RECENT SURVEY in the form of a questionnaire was conducted by the writer to determine the skills, knowledge, and aptitudes needed by civil engineers in the various branches of their profession. The results were desired as a basis for curriculum construction and licensing practice.

An analysis of the results of the questionnaire revealed many general tendencies that might be expected, but there were a few surprises. Surveying has always been recognized as an essential part of civil engineering, not only as a special branch but as a part of the general science of measurement basic to all civil engineering work. Yet the results of the questionnaire showed that neither elementary nor advanced surveying are necessary. But an ability to make field sketches, stake out work, and understand systems of coordinates are professional needs of the civil engineer.

In specific fields many of the results are of considerable interest. The mathematics group of subjects received extremely high scores for inclusion in college curricula. Plane trigonometry stood as the most used branch, with algebra and geometry respectively second and third, or tied. Of the subdivisions of calculus considered, the high ranks were given to applications, maxima and minima, and partial differentiation, with low ranks for hyperbolic functions, implicit functions and elliptic integrals.

Basic Science Rating

Basic science, generally recognized as the *sine qua non* of engineering work, was not ranked very high as a group—being placed thirteenth and fourteenth of the 26 groups. Definite emphasis was placed on basic knowledge rather than problem-solving knowledge. The only basic science subjects of which a comprehensive knowledge was considered necessary to be met through college training, were physics and physiology.

The questionnaire included two definitions of the scientific attitude. Both stood at the top of the list in the results, and were scored almost equal.

There are definite indications in the results of the questionnaire that different fields of civil engineering have different and specialized needs in the basic sciences. Although principles of statics scored first in the random column, it was set twelfth by the surveying group and ninth by the sanitary engineering group. Astronomy was given the rank of 14.5 in the random column but was scored third by the surveying field. Sanitary specialists rated biology higher than did any other group, and ranked knowledge of the nature and behavior of light ninth, although the random sampling rated this need nineteenth. Surveying specialists ranked principles of dynamics $20\frac{1}{2}$, whereas the totals gave this need a rank of 5. Railway and hydraulic specialists set a knowledge of mechanics much

lower than the other fields; and practicing surveyors set knowledge of the nature and behavior of magnetism much higher than did the other fields.

Properties of Materials Stressed

The need for "a good working knowledge of the properties of materials used in construction" was rated highest in the random sampling and close to highest in all special fields except surveying. Ability to make simple computations of stress was ranked fourth in the random sampling and seventh in the structural field, whereas the ability to make difficult computations of stress was rated 24th and 22nd, respectively. The three needs set lowest in the structural group were "ability to detail plate girders," "ability to undertake pure design in the field of structures," and "ability to compute secondary stresses in structures." This field gave an important position to matters of foundations and soil conditions.

In order to separate needs into those to be met through college training, apprenticeship, and aptitudes, a set of criteria was established according to which ten engineering educators and ten practicing engineers indicated where they believed the professional qualifications should be acquired. The classifications were not combined; educators' and practitioners' returns were recorded and studied separately. Differences in classification between the two were not great.

Very little difference was found between the needs of experienced men and the requirements of chief engineers for the younger men they employ. This finding indicates that the difference in needs between the beginning and the experienced engineer is probably only one of degree.

Although the principal aim of the study was to find certain detailed and specific information rather than general impressions, a few broad conclusions are indicated, as follows:

1. Although there is no general agreement among individuals on civil engineering needs, the results of collective observation are very consistent, as indicated by the high correlations in all groups, when checked on alternate halves and in the different geographical divisions.
2. The number of needs included in apprenticeship or service training is very high, numbering slightly more than those to be met in college, a finding which indicates that a complete engineering education cannot be had in college.
3. Many of the needs that are expected to be met through in-service development cannot be satisfied by experience or observation in the field but require organized study in courses or with the aid of textbooks. This conclusion applies particularly to certain needs for designing ability. As only a most unusual student could undertake such studies alone, it seems that there is need for graduate study for engineers who intend to enter the field of design.
4. Needs for business abilities, although few in number, were scored high. Many were classified as to be met through college training.
5. General and basic knowledge takes the highest score in all groups. The general question of specialization is not answered by this study because data have been found to indicate the need for specialized knowledge at all stages of the civil engineer's career. The specific findings with regard to specialization are:
   (*a*) Based on the similarity of their needs, the fields of specialization seem to fall into three groups:
   (1) Hydraulics and sanitary
   (2) Structural, municipal, railroad and highway
   (3) Surveying
   (*b*) The number of needs to be met at the in-service stage, but which seem to require formal study, indicates that specialization will in future demand postgraduate study.
6. Neither the engineering teachers nor the practitioners expect the college course to develop enthusiasm, loyalty, or professional spirit.
7. Ability in management and organization, recognized as important in a wide range, are difficult to develop through college training, both engineering teachers and practitioners agree.
8. The engineering educators believe that more needs are met through college training and less through apprenticeship or experience than the practitioners do.
9. Practicing engineers recognize the contribution of experience as indicated by the large number of items they name as being met through both college and experience.

Program Needed for After-College Training

In general the study showed that engineers are expected to learn a great number of things from apprenticeship or experience. This finding, in addition to the nature of the abilities classified for in-service acquisition, reveals the need for an organized program of internship and postgraduate study, and leads to the recommendation that facilities for such training be made available in as many places as possible.

The lists of professional needs determined by the questionnaire, although not available in printed form, can be obtained on request to the American Society of Civil Engineers. The use of these lists may be helpful to administrators of engineering colleges who contemplate revision of curricula and to teachers who are scrutinizing the content of individual courses. The questionnaire did not cover the content or nature of introductory courses or matters of sequence in engineering education.

Related Fields Are Absorbing
Surplus of Engineering Graduates

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PREDICTION OF the number of engineering positions available in any given period has been studied extensively with varying degrees of success. The Manpower Committee of the American Society for Engineering Education, originally appointed to study this problem, has issued a series of reports beginning

with the Compton Report of 1946 (*Journal of Engineering Education*, September 1946). In summary this report predicted an immediate deficit of engineering graduates. It was thought that this deficit would extend through 1951, amounting to 12,260 for that year and 37,805 for the year 1949.

These figures were rechecked by H. A. Armsby of the U.S. Office of Education, and as a result of utilizing additional data, the revised estimate indicated a surplus for the same two years—18,000 for 1951 and 11,100 for 1949. This revised estimate, published in the *Journal of Engineering Education* for May 1947, was followed immediately by the Report of the Committee on Manpower for that year (*Journal of Engineering Education*, October 1947). In this report the prediction was made that 1949 would find neither a surplus nor a deficit, but that in 1951 there would be a surplus of 26,670.

Many Variables Influence Employment

The number of graduates of accredited engineering curricula is fairly easy to estimate accurately at least four years in advance. Attrition rates are well established for the non-veteran student. These figures reveal that forecasts of engineering manpower have varied from a large expected deficit to the opposite extreme. The question immediately arises, "Can forecasting of this nature be improved?" In order to answer this question it is necessary to make a study of the large number of variables which influence both engineering employment and the supply of engineering graduates.

First, it is desirable to establish reliable methods of predicting the number of jobs available for graduating engineering students on a year-to-year basis. The U.S. Department of Labor in its "Employment Outlook for Engineers," released June 23, 1949, took the first step in this direction by determining the growth of the engineering profession in relation to the total number of workers per engineer over the period from 1890 to 1940. The number of workers per engineer has dropped from 290 in 1890 to 78 in 1940. When the number of workers for a given phase of the economic cycle is known, it is possible to predict the number of engineers who will be needed for replacement and natural growth. Assuming that high levels of general business activity will be maintained and that the United States will not be engaged in another major war within the next decade, it may be estimated that total employment in the major industries using engineers will continue its long-term rise.

Number of Engineering Jobs Predicted

This method of analysis yielded an estimate by the Department of Labor of approximately 17,000 or 18,000 jobs annually for engineering graduates for the next several years. Toward the end of 1950 or 1960 the demand may increase to 21,000 or 22,000 annually. The number of engineering graduates has been estimated by the Department of Labor to be about 41,000 for 1949, 47,000 for 1950, 36,000 for 1951, and 29,000 for 1952, with the assumption that by 1955 the number will have declined to 18,000 and will then probably increase gradually to at least 25,000 in 1965. It is apparent that this prediction indicates a fairly large surplus of engineering graduates may exist in the next few years.

Variables Affect Demand for Engineers

The following variables not often mentioned probably will affect the demand for engineers.

1. Opportunities in Foreign Countries. Increased foreign trade, fostered by ECA, economic aid to industrially retarded nations (Point Four Program), occupation and other similar activities induced by the changing world position of the United States, will increase the number of opportunities in foreign countries for energetic, pioneering young men.

2. Age Considerations. (*a*) *Lower Age of Retirement.* A tendency to lower the age of retirement will affect the number of new men hired. (*b*) *Increased Age on Entering the Profession.* In the immediate postwar period the age of those entering the profession is increasing, thus reducing the "working life" of the engineer. The greater number of engineering graduates who will register for graduate work will increase, thus also decreasing the "working life."

3. Longer Vacations. Professional engineering employees of the future will deserve and take longer vacation periods than has been customary in the past.

4. Teaching Opportunities. The engineering profession probably has not furnished an adequate number of college teachers with industrial experience. In addition, a number of enginering graduates may be absorbed in the high schools and junior colleges.

5. Creation of New Engineering Jobs. A large number of small companies and a number of non-manufacturing organizations, such as retail stores and firms engaged in contracting and transportation, do not yet employ engineers. Men with imagination, the next generation of pioneer professional engineers, will create or find these opportunities.

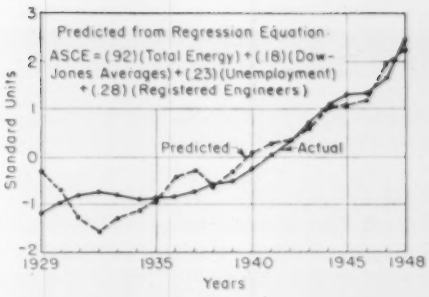

FIG. 1. CURVES SHOW comparison between actual ASCE membership in years 1929–1948 and prediction obtained by Regression Equation, developed by Engineering Department of University of California. Graph exemplifies proposed method of forecasting demand for graduate engineers.

6. Consulting Opportunities. Certain of the engineering requirements of the firms noted under (5) above can be serviced through the small, enterprising consulting firm.

All the above considerations will increase the requirements for engineering manpower, but the magnitude of their effects is not evaluated here.

7. Transfer Into the Profession. The number of college-trained transferees from the sciences will depend greatly on the degree of alertness maintained by the engineering profession, in particular in connection with new developments accomplished by the physicist, chemist, or life scientist, and the new techniques of analysis developed by the mathematician.

The number of non-college-trained professional engineers is approximately 10 percent at this time. The number will increase if certain alert, intelligent young men are not encouraged to study engineering in college, or if the colleges fail to meet the standards of the economy and of the industry.

8. Positions Now Held by Engineering Graduates—Their Future? Over 50 percent of engineering graduates hold administrative, supervisory or sales jobs. Business administration graduates are now being trained for these industrial and business functions and may offer strong competition for these opportunities. Again, a whole series of problems involving safety engineering may fall by default to the public health spe-

cialist unless the engineer is alert to the requirements of modern technology. Also, engineering departments include a number of positions which can be adequately filled by graduates of a two-year technical institute curriculum, such as drafting, estimating and surveying. As more well-trained technical institute graduates become available, the postgraduate in-service industrial training procedures for many four- and five-year engineering college graduates will require revision.

9. Training for Demands of Unknown Magnitude. The responsibility of a profession to society may be variously expressed, but one phase of it would appear to be to ensure that an adequate number of trained men are available to meet emergencies.

Two conclusions follow: First, engineering education must be of such breadth, depth, and value as to permit entrance into other activities and vice versa, with the minimum of difficulty when the transfer becomes necessary. Second, more men should be educated than the profession can absorb, but all students must realize this fact.

10. Immigration and Emigration. The present trend is a net influx into the United States, which will reduce the number of young American engineers required.

11. Displacement of Men Now Holding Engineering Positions. In a period of balance between supply and demand or in the period of low demand, men who have been practicing engineering with a marginal quality of contribution will be displaced by younger, more flexibly minded men. This replacement of men will not increase the total demand but will result in reshuffling within the profession or transfer out of engineering of men who have records of marginal performance. Also, experienced engineers who have built soundly, will transfer into management.

Unforeseen conditions that can readily affect estimates of this nature are sudden changes in technological development, rapid and drastic shifts in the economic cycle, and variables such as the development of some of the undeveloped areas of the world as indicated in the recent Point Four Program formulated by President Truman. Such conditions could readily change the balance from a surplus to a deficit within a relatively short period of time. It is reasonable to expect that predictions will be better and more useful to the profession if they can be based on more than one index, and if some of the indexes can be relatively more sensitive to changing conditions.

A small experimental beginning has been made on this problem at the University of California. A number of national indexes were compiled such as membership of the Founder Societies, retail store sales, total energy, wholesale price index, national income, production index, Dow Jones averages, consumer price index, government non-war spending, number of engineering graduates and registered engineers. These data were reduced to percentages of gain or loss, using 1935 as a common base. A factor analysis was then made of the data for the purpose of determining the significant indexes related to a specific variable. The results were used to formulate a regression equation for predicting the variable. The actual curves and the curves predicted by the regression equation for these data show a fairly high degree of similarity. The multiple correlations of the significant indexes have been obtained for the specific variable.

A multiple correlation of 0.96 for membership of Founder Societies has been found when the significant independent variables are consumer price index, national income, and government non-war spending. For the number of engineering graduates a 0.77 coefficient of correlation was found to exist when the significant variables were the wholesale price index and government non-war expenditure. A 1.00 correlation coefficient was obtained between the number of registered engineers and the significant variables of government non-war expenditures, national income, and engineering graduates.

For the number of members of the American Society of Civil Engineers, a 0.99 coefficient of correlation was found to exist when the significant variables were total energy, Dow Jones averages, unemployment, and number of registered engineers. One of these curves is shown in Fig. 1.

The next step will be an attempt to gather data indicating accurately the number of newly graduated engineering students hired per year by all types of industry for the past several decades. These data will be chosen as the significant variable and an analysis will be made to determine whether there are national indexes that will enable these hirings to be accurately predicted.

No Appreciable Surplus This Year

An important factor is that while at present there appears to be a drop in the total number of engineering graduates being hired by large companies for traditional types of engineering work, the basic engineering training is being found useful in many other occupations. Some of these occupations should have been claimed long ago by engineers and their employment opportunities developed by the profession. Many of these fields require not only engineering knowledge in the physical sciences but also knowledge in the life sciences and the humanities.

A number of deans of engineering throughout the United States indicate that their students are being placed and that they expect no appreciable surplus of engineering graduates this year. This development might be interpreted to mean that engineering graduates are extending their knowledge and training into many other fields of work. A survey made last year of the graduates of a western engineering school reveals that roughly one-fourth to one-third are engaged in work that is not highly technical and for which engineering training may not be essential.

There is serious reason to believe that the constant agitation and publicity that has been given to the great diversity of findings and conclusions as to engineering employment or the lack of it may result in a significant drop in the number of students entering this field. This drop, in turn, may seriously affect our future economy, since the difference between a static or an advancing technological nation is probably closely connected with the number of students entering the engineering profession.

Even if there were at present a large group of unemployed engineers the situation would not be significantly different from the total labor picture for the past year, in which, it may be recalled, unemployment rose from 1,600,000 in October 1948 to the neighborhood of 3,200,000 in March 1949.

An increase of 100 percent in the number of unemployed in a period of a few months would normally decrease the number of engineers being hired. Since the recent engineering graduates have either obtained job offers or are finding employment on their own initiative, the indication is that the training these engineers have received has been basically sound. It has evidently aided them in obtaining employment in a somewhat adverse labor market and in competition with graduates of other types of curricula.

Special Foundations Support Mexico City's Buildings on Highly Compressible Clay

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DEPENDABLE FOUNDATION MATERIAL, in the usually accepted sense, exists only at great depth in Mexico City. Yet, a city of 2,000,000 people, with buildings more than thirty stories high, has been built on soft clays formed of volcanic ash that has a water content up to 500 percent. Buildings settle many feet below the surface; or if they are on long piles they seem to rise several feet since the surrounding ground settles as water is drained from it. A variety of foundation methods have been tried with varying success. To aid in understanding the foundation problem, Mr. Albin gives the geologic and historic background of the plateau on which Mexico City stands and describes various types of foundations used under both old and modern structures. His original paper was presented before the joint session of the Construction and the Soil Mechanics and Foundations Divisions at the Mexico City Summer Convention.

BUILDING FOUNDATIONS have presented difficulties ever since Mexico City was founded by the Spaniards on the site of the destroyed Aztec capital. These difficulties have been met, but not always overcome, in a number of ways—short piles compensating for excavation, spread footings, mat foundations, and, more recently, long piles to bear on dependable deep strata. Great ingenuity in construction, and time, have in great measure offset any lack of mechanical equipment.

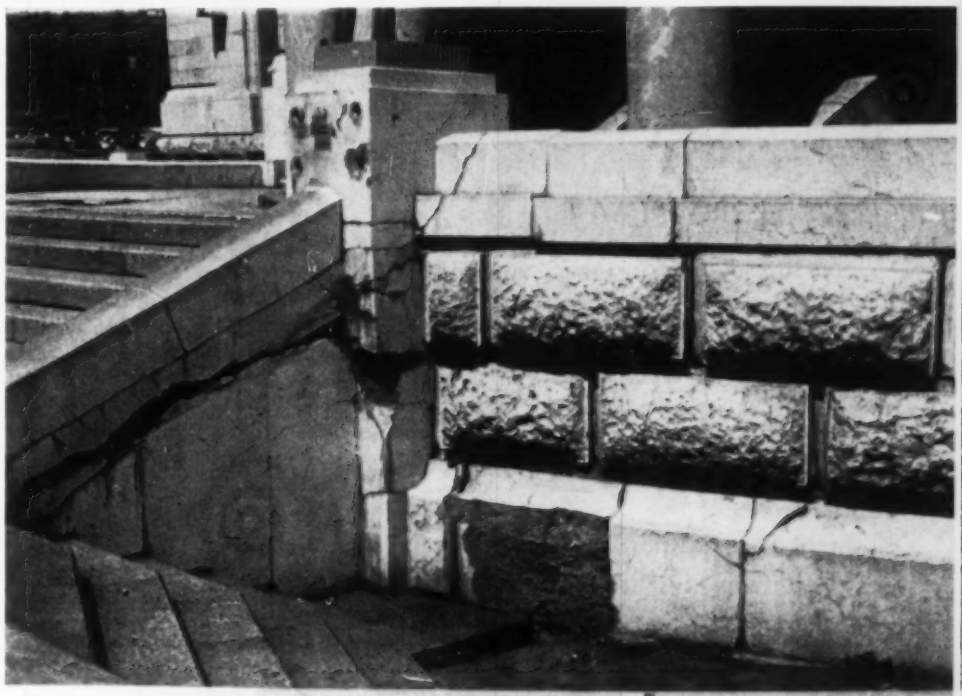
Geologically the location presents a serious problem from the point of view of foundations. Surrounded by mountains, the city lies on a plateau at an altitude of around 7,400 ft above sea level. The plateau is roughly elliptical in shape, with its greater length running north and south. Its level surface is broken by some scattered hills and chains having no apparent relation to the rest of the system. Originally the plateau had no outlet through which the rainwater could escape. The only loss of water was by evaporation, with the result that a lake was formed, the bed of which gradually rose. Explorations have been carried to nearly 2,000 ft and the solid rock base on which the first sediments were deposited has not been found. Some fair bearing material exists at depths of 112 to 230 ft and it is this depth that must be studied for foundations for tall buildings. What lies below this depth is of minor importance.

The Federal District, where the city was originally founded, is in the western part of the plateau. Borings in the city show volcanic sediments and deposits carried by water. In the heart of the city a layer is found at a depth of about 165 ft consisting of gravel and sand, cemented with fine clay. Very active volcanic periods resulted in the deposit of very fine ashes on the surface of the lake. Because of their fineness, these materials settled slowly, forming a very spongy and compressible structure, with an exceptionally high water content. A clay stratum 33 to 66 ft thick, with different colors of clay, was formed in this way overlying the cemented sand and gravel. A layer of variable types of volcanic sands with a thickness varying from 13 to 16 ft lies on top of the clay. Recently piles have generally been driven to bear on this stratum. Its water content—percentage of water to solid matter by weight—is much smaller than the water content of the stratum below.

On the top of this sand layer more ashes were deposited, forming the upper clay stratum which has bentonitic characteristics. The thickness of this layer is about 100 ft. On top of all is a layer of transported clay and artificial fill made by the Aztecs and Spaniards, which varies in thickness from 25 to 35 ft.

In a geologic profile taken in the center of the city, both clay strata are found to be interrupted by thin layers of volcanic sand. These can be easily detected by their resistance to penetration during the sampling procedure and by their low water contents, as found in the laboratory. A geologic profile of a boring carried down 230 ft in the mid-city area is presented in Fig. 1. The sand strata are inclined and get nearer the surface going west from the heart of the city toward the mountains. The lack of uniformity in geologic profiles taken in different parts of the city must be emphasized. To design the foundation for any building of importance, conditions at the site must be investigated.

CRACKS IN STAIRWAY of Palace of Fine Arts indicate settlement of building due to fact that weight it places on soil is greater than elastic strength of underlying clay. Foundation on thick concrete mat reinforced with rolled steel beams, has prevented excessive cracking of superstructure.



CONCRETE BUILDING in Mexico City is tipping as well as settling, although rigidity of concrete raft foundation prevents cracking of superstructure. Man standing on main floor of building, formerly at street level, shows settlement that has taken place in five years.

The Aztecs were the latest tribe to arrive at the plateau from the north. They tried to settle in various places but because of their warlike tendencies were repeatedly driven off by the older and stronger tribes. This nomadic existence lasted for 280 years, when, after a terrible defeat, the remaining Aztecs took refuge on the small island of Acocolco, where they could hide in the reeds. Legend says they found there an eagle sitting on a cactus eating a snake, the sign that their gods had given them to mark their permanent habitation.

On and around this little island they started the city called Tenochtitlán after Tenoch, one of their leaders. The city was enlarged by floating rafts made with water weeds covered with organic deposits from trees, vegetation, and soil. Roots from these "floating islands" reached the bottom of the lake and became fixed. Only channels separated one island from another, and in the course of time these channels disappeared, leaving a single island.

As the Aztecs expanded by conquering neighboring tribes, they connected their island with the mainland by causeways. Floods kept them busy raising the level of the city with soil fill. In spite of floods their religious beliefs obliged them to live where they had built their first temple, and the city grew to a population of 100,000.

After the Conquest by the Spaniards, the conquerors completely destroyed Tenochtitlán in 1521. This was done for psychological reasons, to clear the way for the building of a new city on top of the old one, and to establish a new civilization and a new religion. As floods continued to menace the Spanish city, some means of drainage was sought. A tunnel to carry water out of the valley was completed in 1608, but did not function long. After a flood that lasted from 1629 to 1634, it was decided to construct a channel instead of a tunnel to drain the water from the plateau. Construction started in 1637 and was finished in 1789. This Nochistongo channel is still in use and has many times prevented the city from being flooded.

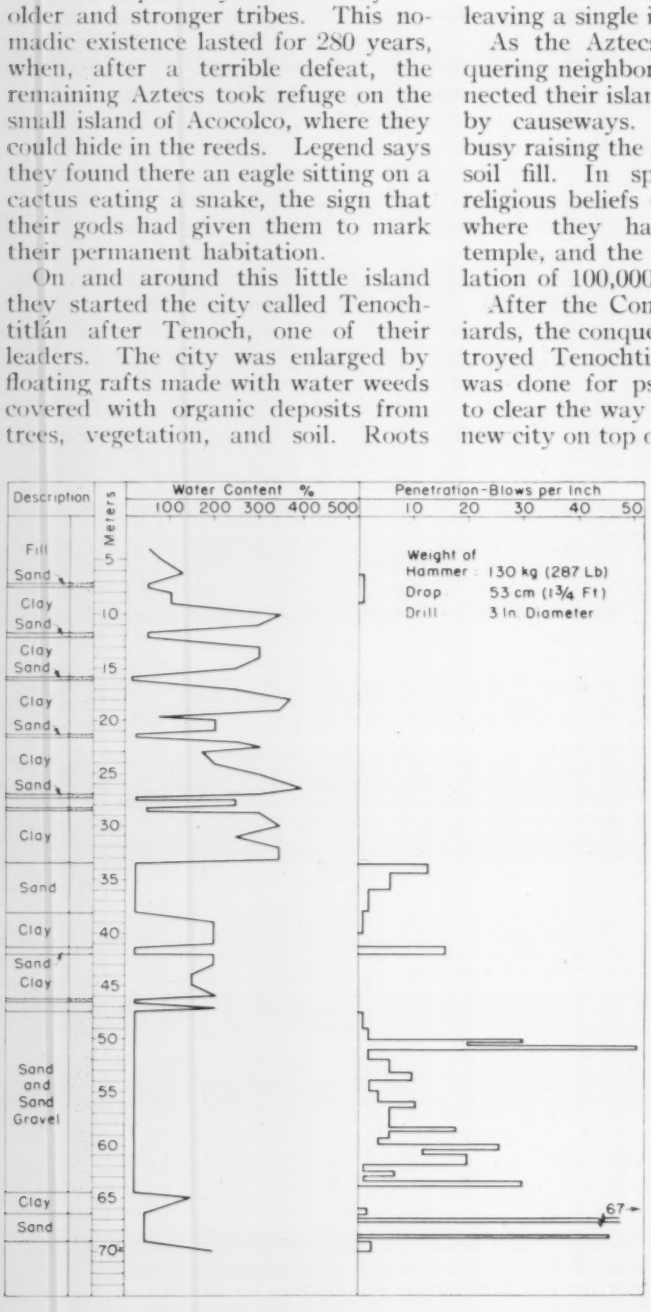


FIG. 1. (LEFT) BORING in downtown area of Mexico City—at Madero and San Juan de Letrán Streets—reveals thick layers of clay alternating with sand lenses to depth of about 230 ft. Note high water content of clay and complete lack of resistance to pile penetration up to depth of about 112 ft.

There are two types of ground settlement in Mexico City—a general subsidence of the whole area and settlements due to local causes. The general subsidence of the area started in 1789 when the plateau was drained. Many wells have been drilled, which also draw water from the sand layers. This water, after being used domestically or industrially, goes out to sea through the sewage system. The general subsidence has become very important recently because of its effect on buildings resting on piles.

Pumping of water from the sand layers causes an interesting phenomenon. The pumping lowers the piezometric level in the sand layers below the general water table, which is found about 7 ft below the ground surface. Because of the high degree of impermeability of the clay layers and the leakage from sewers, the groundwater level is more or less constant—except for a slight variation between the dry and the rainy season. Lowering of the piezometric level in the sand lenses causes what might be called suction of the clay layers, and is one of the main reasons for general subsidence of the city.

Local settlements are caused by the weight placed on the soil by buildings or other structures. The clay underlying Mexico City, although very compressible, behaves elastically up to a certain point. Laboratory tests on both confined and unconfined samples show a nearly straight-line relationship between stress and strain and a definite yield point (Fig. 2). When the stresses on the soil are released, heaving takes place, disturbing the structure of the clay and its resistance to compression. Water contents range from 100 to 500 percent. Therefore, drying causes a very large volume change. Volume of a dried sample might be only one-half to one-sixth of the original.

Foundation difficulties were experienced from the very beginning. Builders tried to avoid differential settlements to prevent cracking and even failure of structures. Short piles have been found under the masonry footings of many of the buildings constructed during the early period of the colony. The writer has had the opportunity of seeing this type of pile during excavation at Madero and San Juan de Letrán Streets, where his company's new

building is being erected and where the convent of Saint Francis formerly stood. When the masonry footings were demolished, rows of piles were found spaced 1 ft center to center. The old piles were generally $6\frac{1}{2}$ ft long and 6 to 8 in. in diameter. They were placed under the footings with the object, it is believed, of consolidating the fill to provide a firmer base for the masonry construction. The short piles fulfilled this purpose, but whatever resistance there was to differential settlement was provided by the strength of the masonry. The masonry was of stone with lime mortar, still found to be of very good quality.

In later foundation practice a wooden grill was built on top of the piles for the support of some buildings. The city's penitentiary has this type of foundation. The piles used were 13 ft long and 10 in. in diameter. Perpendicular to the direction of the wall, timber caps 6 ft long and 10×12 in. in cross section, were placed on top of the piles. Parallel to the direction of the wall, 13-ft-long timbers with a cross section of 10×12 in. were placed and joined to those below by wooden pins. To place the grill on the piles, and to prevent breakage of the 13-ft timbers, the grill was underlaid by a masonry platform. Even early in the construction period, differential settlements could be observed in this building, making it necessary to reduce the thickness of the walls and use lighter materials. The bearing surface was increased by the construction of inverted domes under part of the building, a procedure later used for other buildings.

Timber grills were also used in Colonial times under the whole area of a building to provide rigidity and prevent differential settlement. The squares or rectangles between timbers were filled with well-tamped earth. Care had to be taken in laying the wood so that it would remain immersed in water to avoid decay. The results were satisfactory wherever a more or less uniform soil was found.

In more recent times steel grillages have been used following the same principle as the timber grills. The department store, El Palacio de Hierro, is built on a steel grillage placed under the walls at a depth of 10.7 ft (Fig. 3). The building has behaved well, since rigidity was more or less assured. Nowadays, however, reinforced concrete can be used to provide greater rigidity with less weight and at far less cost.

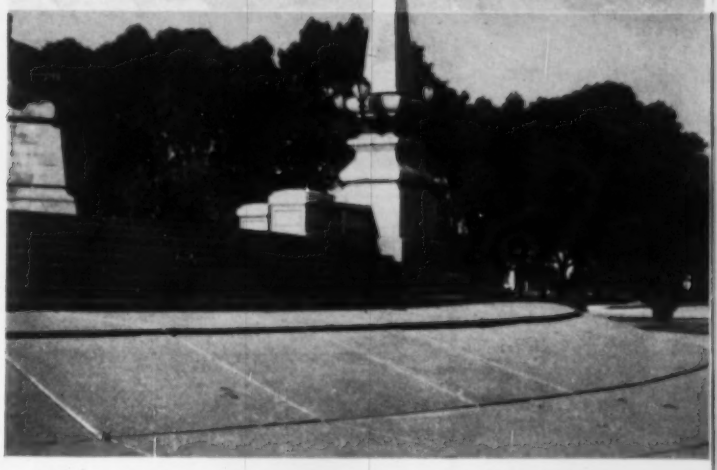
Under parallel columns carrying rather heavy loads, chiefly for churches, inverted domes have been used to spread the load over a larger bearing area. Every column is linked by an inverted arch to the adjacent ones, thus forming half-circle domes intersecting at right angles. This type of foundation was used under the churches of San Francisco and San Felipe on Madero Street. The use of this type of foundation was restricted by its high cost and the extreme care required during construction. Moreover, the materials used had to be extremely good.

Footings can be used for light buildings where the fill is relatively thick. No special precautions are required for the excavation of trenches where the footings are to be placed, but it is necessary to remove superficial organic matter and trash. Footings under load-bearing walls are stone masonry laid with lime mortar. Footings under columns are made of concrete with beams to take the soil reaction.

The bearing area can be enlarged by the use of mat foundations, which are easier to construct than inverted domes. The Cathedral of Mexico is founded on a masonry mat. Lack of reinforcement resulted in recent cracking of the mat, which required very extensive repair work.

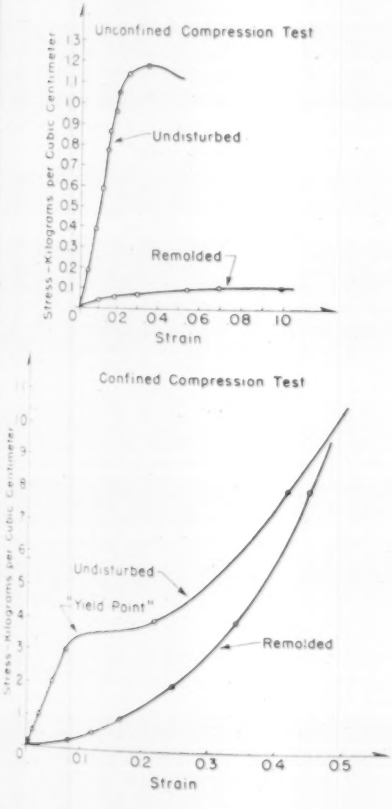
With the development of reinforced concrete, an excellent material was made available for the construction of mat foundations. Part of the weight of the building can be compensated for by excavating but the excavation must be made carefully and not too deep. The stresses induced in the soil must be kept within the straight portion of the stress-strain curve. Settlements can then be estimated and kept within a tolerable range. By designing beyond the "yield point" of the clay, its structure is broken and no accurate predictions can be made as to its behavior.

The Palace of Fine Arts, which is on a very thick concrete mat reinforced with rolled steel beams, has suffered extensive settlements as can be seen from the cracks in the stairs shown in an accompanying photograph. The concrete mat has, however, prevented excessive cracking in the superstructure. The excessive settlements are due to the fact that the weight placed on the soil was



SLANT OF PAVEMENT slabs surrounding Independence Monument illustrates problem that arises when structure built on piles does not settle with surrounding ground surface. Pavement has been relaid several times but area around monument continues to settle.

FIG. 2 (BELOW) CLAY UNDERLYING Mexico City, although very compressible, behaves elastically up to definite "yield point." Laboratory tests on both confined and unconfined samples also show straight-line relationship between stress and strain.



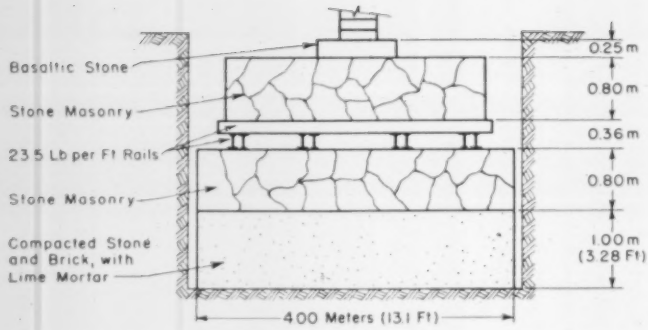


FIG. 3. TYPICAL footing of department store, Palacio de Hierro, shows excavation about 13 ft wide and 10.7 ft deep, containing masonry slab supporting steel rail grillage, which in turn supports footing. Building has behaved well but present cost of this type of foundation is prohibitive.

greater than the elastic strength of the clay.

In the design of a foundation, care should be taken to have the center of gravity of the load coincide with the center of the foundation area so as to produce a uniform stress on the soil and therefore even settlements. An accompanying photograph, showing a concrete building which has settled and tipped, illustrates the importance of this consideration in foundation practice in Mexico City.

For the past thirty years, long wood piles have been used for buildings of importance to transmit the load to sand lenses about 112 ft below the ground, which bear on a clay stratum more resistant than that reached by short piles. Large timber is scarce and expensive in the Mexico City area so spliced piles are used. The piles generally consist of three pieces of wood, each about 35 ft long with a 6- to 8-in. tip and a 10- to 12-in. butt, the pieces being connected by joints such as are shown in Fig. 4: (1) a simple steel pin inserted in the adjoining ends of the piles; (2) an exterior connecting ring besides the central pin; and (3) a special connecting ring acting as a gigantic staple, in addition to the central pin.

Some doubts have arisen as to the effectiveness of the connections between the pile sections, the durability of the piles, and the straightness of the driven piles. When this type of pile is driven, the depth of penetration varies from 3 to 6 ft for adjacent piles. The reason for this variation in penetration is not known. It may be due to splitting of the wood at the joints, crooked penetration, or to inability of the pile to punch through a thin layer of sand.

Care should be taken, and usually is taken, to have the upper part of the pile of concrete to avoid decay because of variations in the level of the water table. Wood piles are designed to carry 20 to 25 metric tons (22 to 27½ U. S. short tons) each.

Long concrete Button-Bottom piles are now being driven for the first time in Mexico City for the new building of La Latino-Americana Cia. de Seguros Sobre la Vida, S. A., at Madero and San Juan de Letrán Streets. These piles, which were developed by the Western Foundation Corp., of New York and Chicago, are well suited to foundation conditions in Mexico City.

The piles are cast in place in the following steps: A prefabricated concrete plug or head is placed on the ground where the pile is to be driven. The plug has a threaded bolt extending upward and is driven by a thick-walled driving casing to the bearing layer. A corrugated light-gage shell is inserted inside the driving casing to reach the plug. Welded at the bottom of the corrugated shell is a pan with a hole in the middle to let the threaded bolt in the plug come through. A special nut with a conic apron is attached to the threaded bolt by means of a centering wrench on a pipe, turned from the top. Concrete is placed to fill the corrugated shell. Finally, the driving casing is withdrawn from the ground.

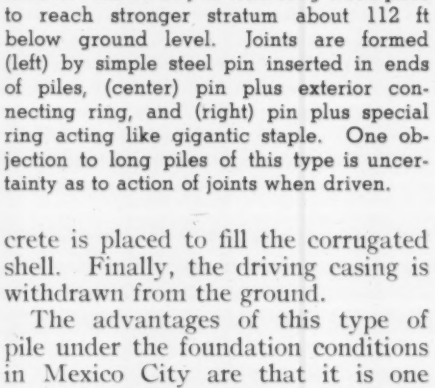


FIG. 4. THREE TYPES OF JOINTS are used in Mexico City to form long wood piles to reach stronger stratum about 112 ft below ground level. Joints are formed (left) by simple steel pin inserted in ends of piles, (center) pin plus exterior connecting ring, and (right) pin plus special ring acting like gigantic staple. One objection to long piles of this type is uncertainty as to action of joints when driven.

The advantages of this type of pile under the foundation conditions in Mexico City are that it is one piece, straight, vertical, and indestructible by water. The base formed by the head or plug, being 17 in. in diameter, stresses the bearing layer around 500 psi with a 50-ton load. Wooden piles with an 8-in. point induce a stress of around 850 psi with a 20-ton load. The factor of safety for penetration in the strata is therefore greater with the Button-Bottom pile and differential settlements are minimized.

The maximum variation in depth of penetration of adjacent piles ranges from zero to 4 in. This means that all piles are bearing on the same stratum. Differential settlements are also reduced. Conservation of the forests is another important factor in Mexico.

Because of the gradual settlement of the whole city area, the ground floor of buildings on piles is soon left at a higher level than the surrounding ground. This difficulty is graphically illustrated by the accompanying views of the Independence Monument in Paseo de la Reforma. The sidewalk has been relaid several times but the difference in levels continues to increase as shown by the slant of the slabs. To avoid this difficulty in the case of the building under construction at Madero and San Juan de Letrán Streets, it is proposed to mount the ground-floor slab on screws so that it can be lowered as the area settles. This expedient promises to provide a practical and economical solution. Of course the architectural design of the basement must allow for the lowering of the slab.

Whether a mat or a pile foundation is used, great care should be taken to avoid disturbing the soil at the site and under neighboring buildings and streets while excavating. Excavation is sometimes necessary to reduce the overburden and take advantage of the uplift pressure of the groundwater. Sufficient material should be excavated to reduce stresses below the "yield point" of the clay.

In excavating below the water table, long periods of pumping should be avoided unless the water is reintroduced into the soil close to the excavation. Neglect of this precaution could lower the water table and cause considerable settlement of adjacent buildings and streets. Once the excavation has been made, the load must be replaced on the soil to prevent heaving. The foundation should be placed soon after excavating, or partially placed before excavation is completed.

Water must not be permitted to rise above the bottom of the excavation, since heaving would be accelerated by the lack of capillarity at the surface. The considerable heaving that takes place in Mexico City's soil alters the properties of the clay and reduces its strength.

Water Resources—*Mexico's No. 1 Problem*—Holds Spotlight in Technical Sessions

Six ASCE Technical Divisions Present Programs at Summer Convention in Mexico City

Economic Benefits to Both Countries Result from Boundary Commission Work

IRRIGATION was described as Mexico's prime problem by Antonio Rodriguez L., director general of water development for the Ministry of Hydraulic Resources, Mexico City, in a special general session on the water resources of Mexico, held on Wednesday afternoon. In his paper, "Human Aspects of Mexican Irrigation," Mr. Rodriguez stated that about 93 percent of the country is arid or semiarid, without sufficient rainfall for agriculture.

The activities of the International Boundary and Water Commission, United States and Mexico, in the development of joint water resources were explained by L. M. Lawson, Hon. M. ASCE, commissioner for the United States, in the lead-off talk, to which the Mexican commissioner, Ing. David Herrera Jordan, responded. Utilization of the hydraulic resources of Mexico was discussed by Ing. Adolfo Orive Alba, secretary of the Ministry of Hydraulic Resources, in another leading paper. The final paper on "Passing Flood Waters Over Dams During Construction," was presented by another ASCE Honorary Member, Andrew Weiss, chief of the consulting department for the Ministry of Hydraulic Resources.

Royce J. Tipton, M. ASCE, consulting engineer of Denver, Colo., was presiding officer for the session which was the only one scheduled for Wednesday afternoon. Papers for this session which were received at ASCE Headquarters prior to the Convention are reviewed below.

L. M. Lawson

In recent years conflicts and disputes over boundary matters, so prevalent between other countries of the world, have been strikingly absent between the United States and Mexico. Our relations, states Mr. Lawson, are an example of what may be accomplished by practical cooperation. Both our countries have benefited economically and socially by the development of communities which are in turn greatly stimulated by the projects planned and constructed by the International Boundary and Water Commission. There has been no loss of individuality by either country

Royce J. Tipton, Consulting Engineer, Denver, Colo.

because of this cooperation, declared the author. There has been a profound realization of the necessity of working together in order to secure the maximum benefits inherent in a common water supply.

Since its inception in 1889, the Commission has acted to conserve the millions of wasted acre-feet of water that has flowed from the Rio Grande and Colorado Rivers and also to protect the adjacent properties from the destruction of rampaging floods. It has acted upon over 200 land changes to the end of preserving the river boundary between the two countries. In 1927 it became an engineering organization with a more expanded engineering program.

To the work of planning and design, states Mr. Lawson, the technical advisers both private and federal of both countries have contributed expert and valuable services.

Antonio Rodriguez L.

Although irrigation has been practiced in Mexico since the days of the Aztecs, Mr. Rodriguez stated in his paper, it was not until 1926 that an irrigation program was initiated on a national scale. Under the 1926 irrigation law, which was in effect for 20 years, such irrigation works as the Don Martin and Conchos River projects were developed. Though it was hard at first to induce farmers to move into the irrigated areas, the demand for irrigated acreage is now so great, according to Mr. Rodriguez, that the government has not been able to meet it. In some cases resettlement of population has been found necessary.

The present irrigation law, which was established in December 1946, seeks to correct inequalities in the former law by limiting ownership of irrigated lands to about 250 acres. Owners of land in excess of this amount must either subdivide their property or sell the additional acreage to the government. Mr. Rodriguez stated that reforms still to be made include elimination of speculation among owners who try to sell land at too high prices; establishment of bona fide farmers on lands occupied by tenant farmers, who work the land for large landowners; and readjustment of minimum uneconomical holdings of less than 12 acres.

Although construction of many of the Irrigation Districts now in operation was started under the 1926 law, settling and repayment charges have been established under the 1946 law. These include the Laguna, Culiacan, lower San Juan River, lower Rio Bravo, and other well known districts.

Improving the economy of the "rural masses of Mexico" is called a dominant aim of the present irrigation program. To this end, Mr. Rodriguez advocates planning all projects from the viewpoint of the greatest good to the greatest number of persons, and of coordinating engineering and social aspects of irrigation projects. The different methods of water distribution that have been tried, he said, include "continuous service," "rotation among users," "rotation among distributing canals" (especially on streams where no storage has been constructed), and "free demand." Present irrigation charges average from $500 to $700 per hectare (2.47 acres), the charges repre-

senting from 33 to 46 percent of present average costs.

Since water is scarce in Mexico, Mr. Rodriguez emphasized the necessity for utilizing "every available drop in proper irrigation, hydroelectric, and multiple-use developments." Quoting hydrological studies made by the Ministry of Hydraulic Resources, he stated that the irrigation of approximately 16,802,800 acres can be accomplished by storage dams. Good use of underground water will permit irrigation of an additional 2,500,000 acres. To facilitate the working out of the government's present program, Mr. Rodriguez stressed the need for attention to administrative, engineering, and operational aspects.

Andrew Weiss

In his paper on "Passing Flood Waters Over Dams During Construction," Mr. Weiss showed that the increasing necessity of using earth dams in Mexico, because of the diminishing number of sites available for construction of masonry or concrete dams, has created new problems in dam construction. These problems are especially troublesome in locations where climatic, geologic, and topographic conditions tend to produce floods difficult to control by the means usually employed, such as tunnels or covered conduits, he stated. Scarcity of equipment and repair parts, lack of trained personnel, and limitation of funds are other factors adding to the problem of dam construction in Mexico, according to Mr. Weiss.

Mr. Weiss described the application of the overflow method of flood control, which has gained wide favor in Mexico as a solution to problems of flood control during dam construction, to a number of important dam projects in Mexico. His paper will be published in full in a forthcoming issue of PROCEEDINGS.

Control of Rivers
Features Joint Division Session

FOUR YEARS of trouble-free operation of a high-head Francis unit installed in Mexico's Ixtapantongo hydro power plant satisfied the country's acute need for power and proved the wisdom of the choice of this type of turbine. Following this period of service the turbine was completely dismantled and repaired, as explained by Messrs. R. B. Willi and W. R. MacNamee in their paper presented before the joint session of the Waterways and Power Divisions at the Mexico City Convention, and printed elsewhere in this issue. Both authors are connected with the Baldwin Locomotive Works, Philadelphia, Pa. The session was presided over by Milton G. Salzman, M. ASCE, Chairman of the Power Division's Executive Committee and by Gerard H. Matthes, Hon. M. ASCE, Consulting Engineer, New York, N.Y. Mr. Salzman, Hydraulic Engineer, Ebasco Services, Inc., New York, opened the session with a discussion of the "Objectives of the ASCE Power Division."

Three other papers were presented at the session; "Water Power Development in Mexico," by Ing. Alijandro Paez Urquidi, Director General, Comision Federal de Electricidad, Mexico; "Rectification of the Rio Papaloapan," by Ing. Reynaldo Schega C., Project Engineer, Comision del Papaloapan of the Ministry of Hydraulic Resources; and "Control Problems on the Colorado River," by Carl Vetter, M. ASCE, Senior Engineer, U. S. Bureau of Reclamation, Boulder City, Nev.

Milton G. Salzman, Chairman, Executive Committee, Power Division; Civil Engineer, Ebasco Services, Inc., New York, N.Y.

Gerard H. Matthes, Hon. M. ASCE, Consulting Engineer, New York; former director of U. S. Waterways Experiment Station, Vicksburg, Miss.

Soil of Low Bearing Capacity
Complicates Mexico City Foundations

A SOIL BEARING CAPACITY of only a half ton per sq ft and the fact that the entire plateau is gradually sinking, complicate the problem of constructing building foundations in Mexico City. Methods of overcoming these difficulties were discussed by Ing. Leonardo Zeevaert, Assoc. M. ASCE, in his paper, "Present Building Foundation Problems in Mexico City," presented before the joint session of the Construction and Soil Mechanics and Foundations Divisions, presided over by Carlton S. Proctor, Vice-President of ASCE. Mr. Zeevaert, a consulting engineer of Mexico City, is Visiting Research Associate at the University of Illinois.

Other papers read before the session were by Ing. Pedro Albin, Jr., Jun. ASCE, Construction Engineer for La Latino-Americana, Mexico City, printed elsewhere in this issue under the title, "Special Foundations Support Mexico City's Buildings on Highly Compressible Clay"; by Ing. Paul J. Marsal, Engineer of Mexico's Bureau of Hydraulic Resources, on "Soil Research on Fine Sand for Core of Alvaro Obregon Dam"; and by Dr. Nabor Carillo, Professor of Civil Engineering at the National University of Mexico, Mexico City, who discussed "Strain Disturbance Produced by a Rigid Pile in an Elastic Mass." Papers received at Society Headquarters prior to the meeting, and not appearing elsewhere in this issue, are reviewed below.

Leonardo Zeevaert

The volcanic lacustrine clays underlying Mexico City have been a constant source of difficulty to the city's builders, Mr. Zeevaert stated in his paper. Not only are the bearing capacities extremely low—0.5 ton per sq ft—but the entire plateau is slowly sinking. Mr. Zeevaert divides the many types of foundations proposed as solutions to this problem into three main groups—narrow footings, mats, and long piles.

Narrow footings are generally used where the soil characteristics are well established and are therefore usually

successful. Mats, used with large, heavy structures, have not enjoyed as much success, since the heavy surface loadings involved may destroy the original clay structure, and very large

Carlton S. Proctor, Vice-President, ASCE; First Chairman, Soil Mechanics and Foundations Division; Consulting Engineer, New York, N.Y.

settlements have sometimes taken place, up to 4 or 5 ft in a few years. Moreover, nearby construction may alter the position of the water table, unbalancing the mat and causing the building to tip, sometimes several feet.

Long piles driven to a stratum of coarse soil or sand have been quite successful in reducing the settlement of heavy buildings, but the general settlement of the plateau, in some places as much as 4 or 5 in. a year, leaves the structures perched on top of the piles with the ground gradually falling away from them.

No definite rules for constructing foundations in Mexico City can be given, declares Mr. Zeevaert, because of the present complex situation. In order to solve current problems in a more satisfactory manner it is necessary for the foundation engineer to study carefully the loading history of the site, including present seepage forces, and to learn the behavior of the natural clay deposit by experience in the field. The study may be aided by an investigation of the physical properties of the clay by means of the best undisturbed samples.

Nabor Carillo

In investigating the influence of cemented well casings on the deformation of subsoil in a subsiding area, short casings should be considered perfectly rigid, while long casings behave as if very much compressible. Long rods (casings) follow the soil deformation except at the ends of the tube, where important disturbances may be produced, Dr. Carillo stated.

The author divided his investigation into four major sections. The first section, "Disturbance Produced by a Rigid Rod (Cemented Casing) or the Deformation of a Uniformly Compressed Elastic Mass," he stated, is based on the following assumptions:

1. The well casing is a perfectly rigid cylindrical tube.
2. The stresses developed between the rod and the surrounding soil at the contact surface, are smaller than the bond. Thus perfect cementation is assumed.
3. The soil is assumed elastic and homogeneous, and its deformation is uniform and parallel to the axis of the well.
4. Kelvin's solution for the problem of a concentrated force in the interior of an infinite elastic mass is applied.

In the rest of his paper Dr. Carillo discussed the other three major subdivisions of his investigations, as follows:

II. Influence of the Compressibility of the Casing

III. Rigid Casing in a Semi-Infinite Elastic Solid

IV. Compressible Casing in a Semi-Infinite Solid

Long-Range Program Develops Mexico's Water Supplies for Irrigation

SCARCITY OF WATER, due basically to limited and sporadic rainfall, makes irrigation a necessity in large sections of Mexico. For this reason the government has sponsored, since 1926, a long-range program of construction of dams and other works to increase the irrigable area and store water for domestic and other uses. Various phases of this program were described in papers presented before the two sessions of the Irrigation Division at the Mexico City Convention.

Both sessions were presided over jointly by C. M. Ainsworth, Chairman of the ASCE Irrigation Division and Principal Engineer of the International Boundary and Water Commission, United States and Mexico, and J. C. Bustamante, Jun. ASCE, Principal Engineer of the Mexican Section of the Boundary Commission.

At the first session on Thursday morning two papers were presented: "Design of Irrigation System," by W. H. Nalder, M. ASCE, Chief Designing Engineer, Bureau of Reclamation, Denver, Colo.; and "The Hydrology of Mexico," by Ing. Andres Garcia Quintero, Director of the Department of Hydrology of the Ministry of Hydraulic Resources, Mexico City.

C. M. Ainsworth, Chairman, Irrigation Division; Principal Engineer, U.S. Section, International Boundary and Water Commission, U.S. and Mexico

At the afternoon session on the same day, three papers were read. The first, by Raymond A. Hill, M. ASCE, Consulting Engineer, Leeds, Hill and Jewett, Los Angeles, Calif., dealt with the subject of "Operation and Maintenance of Irrigation Systems." The second, on design and construction of dams in Mexico to store water for irrigation, was by Ing. Jose Vicente Orozco, Assoc. M. ASCE, Chief Engineer of Irrigation, Ministry of Hydraulic Resources, Mexico City. This paper is printed elsewhere in this issue under the title, "Mexico Builds Irrigation Dams to Suit Local Conditions." The third paper, "Cement Technology in Mexico's Reclamation Work," was by Ing. Federico Barona de la O, Engineer of the Ministry of Hydraulic Resources, Mexico City.

Papers received at Society Headquarters prior to the Convention, and not appearing elsewhere in this issue, are reviewed below.

W. H. Nalder

Irrigation development by its very nature must increase in complexity as it progresses, Mr. Nalder stated. Development of an area through irrigation, he said, fosters the development of natural resources—

land, mineral, and forest. Settlement is encouraged, including the building of farms, cities and industries, and population increases, requiring more food, domestic water, power, and transporation facilities. All these elements are brought together or into conflict over the common denominator of the available water supply.

J. C. Bustamante, Jun. ASCE, Principal Engineer, Mexican Section, International Boundary and Water Commission

Although Mr. Nalder did not try to present all the factors involved in the irrigation problem, he did present a few of the major elements and their implications and effect upon irrigation design. Among these major elements he included power, flood control, navigation, industrial-domestic use of water, recreation, fish and wild life, and politics. To illustrate the necessary steps in developing and planning a multiple-purpose project, he described a typical area interested in irrigation and outlined the progress of the program as it might be handled by the Bureau of Reclamation, from initial studies to completion of the contract.

The speaker also gave brief resumés of the Columbia Basin Project and the development of the Republican River Basin.

Irrigation engineering may become in the forseeable future of much greater importance than it has been in the past, Mr. Nalder concluded, but it will not be irrigation engineering alone. The design of irrigation systems will be linked with the design of facilities to utilize all the water available in more extensive and more complex multiple-purpose projects or basin developments than have yet been constructed.

Andres Garcia Quintero

Water, the most precious of all natural resources, is and always will be scarce in Mexico, Mr. Quintero said in introducing his subject. Why this is so formed the theme of his paper. As rainfall represents the source of Mexico's water, he began his paper with a description of the factors that control its distribution and occurrence.

These factors were listed as its geographical position, in a desert belt; the location and extent of its mountain systems, which determine the rainfall distribution—greatest along the Gulf of Mexico; the influence of the movement of air masses and fronts; and finally the occurrence of tropical cyclones, which are so prevalent in August and September as to require inclusion among the main hydrologic factors. From the engineering point of view, cyclones impose very unfavorable conditions, he explained, as they call for very large capacities in spillways and flood control facilities. The maximum discharges ever recorded are for rivers in the northeast and were caused by cloudbursts produced by cyclonic disturbances.

In Mexico 75 percent of the annual rainfall occurs in the summer months (June, July, August and September) except in the northern part of Lower California, where most of the precipitation occurs in winter. Summarizing the hydrology of Mexican rivers, Mr. Quintero described them as intermittent with the highest percentage of runoff occurring during the summer months, with a very small or no discharge in the dry season, with very rapid floods with large discharges, and long periods of drought lasting several years in many basins in the northern Central Plateau and in the northwestern region. There are only three or four navigable rivers, he said, on the coast of the Gulf of Mexico; in the rest of the rivers it is impossible to sustain continuous discharges.

Comparing Mexico with the United States, Mr. Quintero said that the total surface runoff in the latter is more than six times that of the former and that the Columbia River system equals in volume all the surface waters of Mexico.

The paper concluded with two appendices, giving mean annual runoff in Mexico according to 19 regions and listing maximum river discharges for a large number of rivers in these various regions.

Federico Barona de la O

Stressing the importance of portland cement in the construction of Mexico's reclamation projects, Mr.

(*Continued on page 74*)

Mexico's Road-Building Program Furthers Economic Development

ECONOMIC DEVELOPMENT resulting from road building was the theme of the opening paper presented before the Highway Division session on Thursday morning. The author, Ing. Romulo O'Farrill, is president of the Asociación Mexicana de Caminos, Mexico City. The session was presided over by Charles M. Upham, Chairman, Highway Division Committee on Highway Construction.

Four other papers were presented, as follows: "Feeder Roads on the Federal Road System," by Ing. Rene Etcheren, Chief, Bureau of Rural Roads, Direccion Nacional de Caminos, Mexico City; "Federal Road Program," by Ing. Armando Salinas, Director General of Highways, Secretaria de Comunicaciones, Mexico City; "Aerial Surveying for Highway Locations and Engineering in Tropical Countries," by William T. Pryor, Assoc. M. ASCE, Public Roads Administration, Washington, D.C.; and "Mexican Road Building Methods," by Ing. Jose Rodriguez Cavo, Sub-Director General of Highways, Mexico City.

Charles M. Upham, Chairman, Committee on Highway Construction, Highway Division; Engineer-Director, American Road Builders Association, Washington, D.C.

Service Record Justifies Choice of Francis Unit for Mexican Installation

R. B. WILLI and W. R. MacNAMEE

I. P. Morris Engineering Department, The Baldwin Locomotive Works, Philadelphia, Pa.

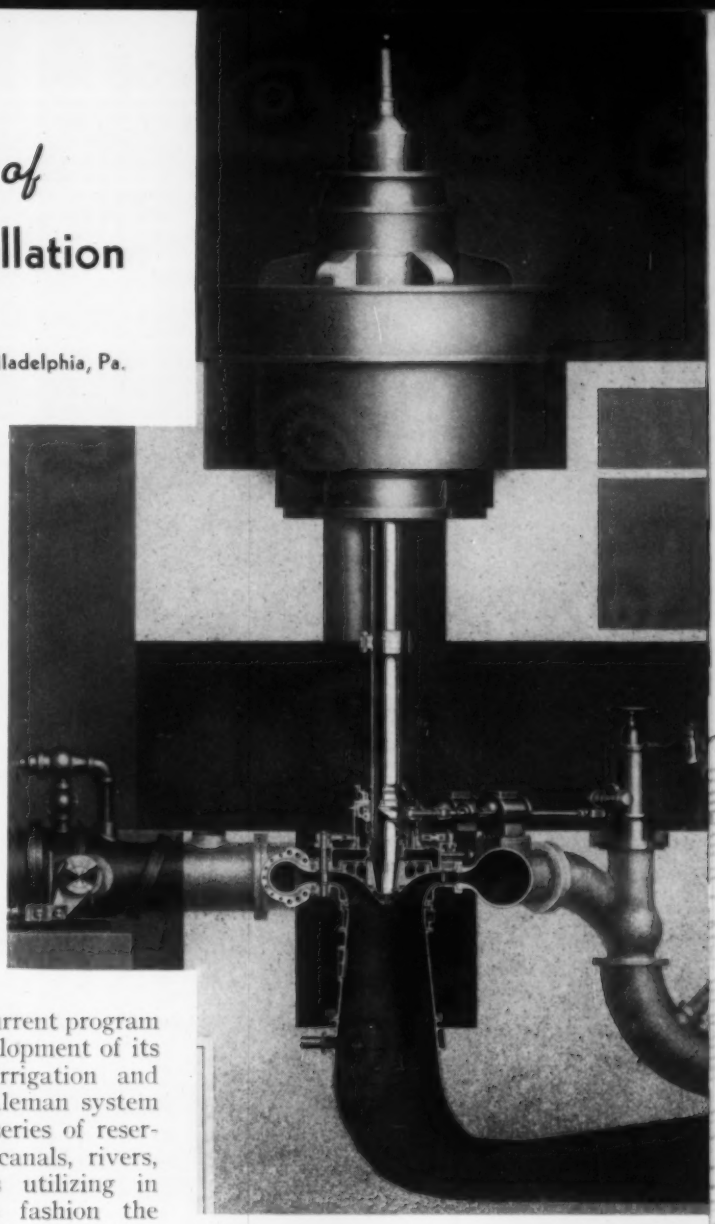


FIG. 1. SECTIONAL VIEW of Ixtapantongo hydro unit shows 39,000-hp, 1,028-ft-head, 600-rpm Francis hydraulic turbine, designed and built for Mexico's Comision Federal de Electricidad by Baldwin Locomotive Works. Man standing by relief valve at right shows scale.

CONSIDERABLE SAVING in the initial cost of the Ixtapantongo hydroelectric power plant was realized by the choice of a Francis-type unit instead of a Pelton wheel. In making this choice, the engineers of Mexico's Comision Federal de Electricidad had to weigh many factors, as the choice was "by no means obvious." It was realized that the design would have to be carefully developed to minimize damage to the turbine over a period of years and to facilitate maintenance. Because of the urgent need for power, this high-head (1,028-ft) installation was kept continuously in service four years before it was dismantled for maintenance and repair. It has now been completely renovated and resurfaced with stainless steel weld where required. Operating experience has fully justified the choice of the Francis-type unit, Messrs. Willi and MacNamee conclude in this paper, which was initially presented before the joint session of the Waterways and Power Divisions at the Society's Mexico City Convention.

FORTY-FIVE MONTHS of continuous trouble-free operation have proved the wisdom of choosing a Francis turbine for the 1,028-ft-head Ixtapantongo power plant on the Tilostoc River in Mexico. Deferment of all maintenance for this length of time, far beyond the most economic period, was made necessary by the urgent need for power in Mexico. When the second unit was finally installed to carry the demand, the first was shut down and completely disassembled and renovated. Although considerable wear and pitting were found, the condition of the various parts was not serious and repairs were easily made by means of stainless steel welding, combined with stainless steel plate where required.

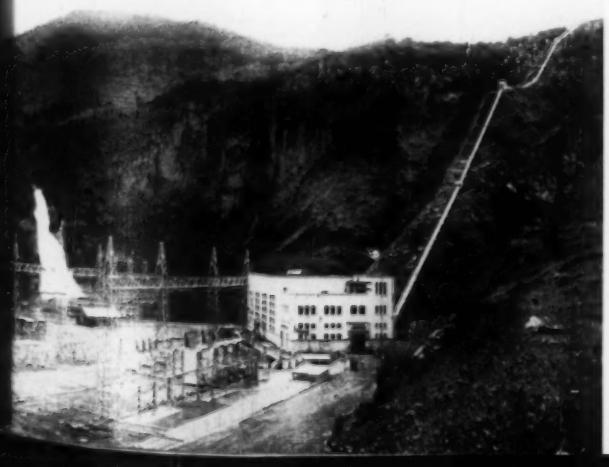
The Ixtapantongo Plant is the first development of the Miguel Aleman system, one of the most important elements in Mexico's current program for the large-scale development of its water resources for irrigation and power. The Miguel Aleman system is a highly integrated series of reservoirs, interconnecting canals, rivers, tunnels and pipelines utilizing in unique and ingenious fashion the tributaries of the Rio Cutzamala. The power is transmitted 75 miles, mostly for use in Mexico City.

Part of Closely Integrated System

The Ixtapantongo Plant is on the Rio Tilostoc, one of the two rivers forming the Cutzamala, which flows into the Rio Balsas system. Two storage reservoirs have been constructed on tributaries of the Tilostoc, the Valle Victoria and the Valle de Bravo, the first being at a much higher elevation than the second.

Eventually these two reservoirs will be connected and the difference in elevation will be utilized for power development. The flow from the Valle de Bravo Reservoir will be used by the Durazno Plant, now under construction. From the future tailrace at Durazno a dam on the Tilostoc diverts the flow through a canal and tunnel to the Colorines Reservoir nearly two miles distant, which forms the forebay for Ixtapantongo, to which it is connected by a second canal 1,700 ft long, a 2,350-ft tunnel, a short pipeline and individual penstocks 3,440 ft in length. Provision is made in the pipeline and Ixtapantongo powerhouse for three units. Downstream from Ixtapantongo there will be another power station.

A surge tank is provided near the downstream end of the tunnel at Ixtapantongo and there are butterfly



IXTAPANTONGO POWERHOUSE and switchyard are at foot of Ixtapantongo Falls (left) on Tilostoc River, about 75 miles from Mexico City. Single penstock 3,440 ft long leads up to canal and tunnel which connect with Colorines forebay, about 1½ mile from powerhouse.

RUGGED TOPOGRAPHY determines layout of Ixtapantongo hydroelectric development here seen from air. Powerhouse is in center foreground, about 75 miles west of Mexico City. Colorines forebay is in middle distance at right, and Valle de Bravo Reservoir in upper left background. Drop in elevation between reservoir and forebay is about 460 ft, and between forebay and powerhouse, about 1,060 ft.

valves at the upstream ends of the penstocks to permit dewatering of each pipeline for maintenance.

This project was begun before the war, the outbreak of which in 1939 prevented the delivery of two hydroelectric units ordered from Europe. Contracts for the first unit were placed with American manufacturers in 1941 and for the second unit in 1944. The generator, control and switchgear equipment were furnished by The Westinghouse Electric Corp., and The Baldwin Locomotive Works furnished the turbines, relief valves, governors and butterfly valves.

Economy Dictates Choice of Francis Turbine

Choice of a Francis-type turbine rather than a Pelton wheel for the Ixtapantongo plant was by no means obvious, and involved the weighing of many factors by the engineers of Mexico's Comision Federal de Electricidad. The Pelton wheel has certain important advantages over the Francis unit for the high head and large capacity involved here, such as simpler construction, no close running clearances, higher efficiency at light loads below, say, one-third rating, and less susceptibility to excessive damage by cavitation or by sand suspended in the water. The parts subject to wear or cavitation are also relatively accessible and easy to repair or replace.

On the other hand the Francis unit is lower in first cost owing to the relatively light parts and high speed, the latter factor reducing the generator size and cost very materially. The reduction of machinery size permits a smaller, less expensive powerhouse, still further lowering the initial cost. The efficiency attainable at loads above the one-third point is appreciably higher than for the Pelton type. In many cases the final choice depends upon the quantity of sand and silt expected in the water.

In order that the reduction in first cost would represent a real saving over the life of the turbine, it was essential that the design be carefully developed to minimize damage and to facilitate maintenance and repair.

The two turbines now installed at Ixtapantongo are rated at 39,000 hp each under a head of 1,028 ft at 600 rpm. The generators, rated at 31,000 kva with a 90 per cent power factor, have a continuous overload capacity of 15 percent. Voltage is 13,200.

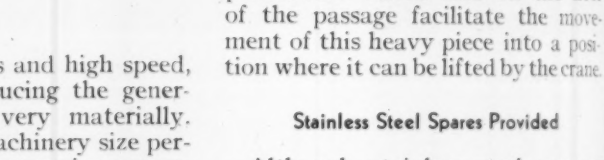
One of the problems confronting the turbine designer is the fact that generator rotors for high-head turbines become proportionately smaller in diameter as the head increases because of the greater speed. This condition reaches the extreme point where, for very high powers and high heads, it is necessary to use Pelton turbines to operate at lower speeds. At Ixtapantongo, the inside diameter of the stator would not permit the conventional method of disassembly, which consists of removing the generator rotor and lifting the turbine parts through the stator. Rather than move the stator, which would disturb alignment and add to maintenance expense, the turbine was designed to permit removal of the runner from below, as shown in Fig. 1.

A passage from the draft tube under the turbine casing connects with a hatchway accessible to the powerhouse crane. Detachable wheels on the upper draft-tube section and permanent tracks laid on the floor of the passage facilitate the movement of this heavy piece into a position where it can be lifted by the crane.

Stainless Steel Spares Provided

Although stainless steel was not available in quantity for use at strategic points on the turbines because of the war, the design was made such that parts most vulnerable to damage could be readily replaced when this material was again obtainable. The Comision Federal de Electricidad has since purchased stainless-steel guide vanes, throat ring and runner cap to carry as spares.

The cast-steel runner has an inflow tip diameter of 70 in. and a throat diameter of $49^{5}/_{8}$ in., and is provided with steel wearing rings shrunk on at top and bottom. To minimize leakage, the clearance between these rings and their matching stationary rings was held to $^{1}/_{8}$ in. on a side. For disassembly from below, the runner was attached to the shaft by a tapered



TWO 28,000-kw generators are in operation in Ixtapantongo powerhouse. One governor actuator appears at extreme right. Turbine parts are dismantled from below and removed through openings in floor. Control room, high above floor, affords view of switchyard as well as generators.

fit rather than by a flange, which would not have been accessible for unbolting.

There are sixteen guide vanes, the stems of which extend through the bottom and top covers. While this arrangement necessitates an extra set of stuffing boxes underneath the turbine, it is by far the most satisfactory method of eliminating the objectionable hydraulic thrust otherwise resulting from water pressure beneath the lower guide-vane stem. Shear pins in the guide-vane linkage can be quickly replaced if broken by an obstruction merely by setting the gates at about 20 percent opening long enough to drop a new pin into position.

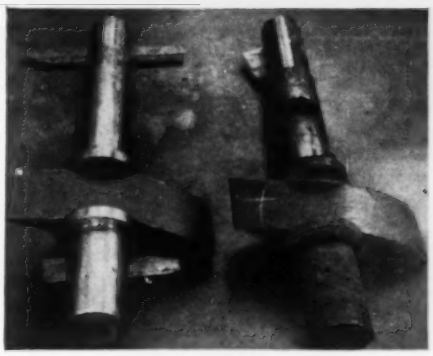
The casing is cast steel, in three sections each with integrally cast stay vanes. All other major parts, including the operating ring, are cast steel.

An air pipe brought to the turbine head cover contains a valve which automatically opens when the gates approach the closed position. The inflow of air at small gate openings acts to lessen any tendency toward rough running and surging, and also prevents parting and rejoining of the water column in the draft tube when the gates are closed quickly, following a sudden loss of load.

The turbine governor, type GM of the Woodward Governor Co., is of the oil-pressure actuated type, the oil pressure being supplied by a motor-driven gear-type pump. A hand pump affords a means of control in the event of complete loss of oil pressure.

GRINDING (at right) smooths upper distributor wearing plate after repair by stainless steel weld.

PITTING (below) along top of turbine throat ring was repaired by welding after 45 months of continuous operation in Ixtapantongo hydro plant.



GUIDE VANE (just above) after repair by welding of top, bottom and contact edges and polishing of stems, is placed beside similar vane as removed from turbine.

TURBINE RUNNER REMOVED after 45 months of continuous operation, shows pitting of vanes (upper view), which were repaired by stainless steel weld (lower view).

Difficulties of Speed and Pressure Control

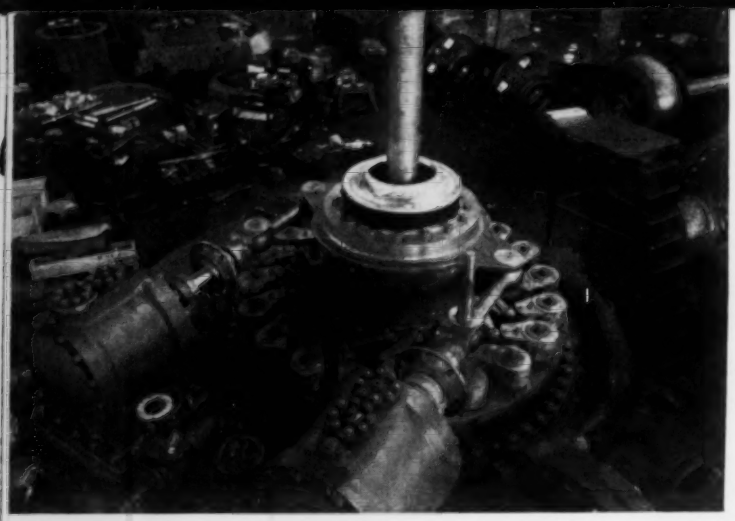
The simple fact that water flowing through a conduit represents a form of kinetic energy is very troublesome to hydraulic engineers, particularly in the design of hydroelectric plants with long closed conduits. Proper speed regulation of generating units requires that the flow through the turbine be adjusted promptly to the load demand. Unfortunately, the kinetic energy of the flowing water is not easily destroyed or increased.

Calculation of the pressure rise resulting from an attempt to close the turbine gates quickly in a typical high-head plant will yield a value which would be absolutely prohibitive from the standpoint of penstock design. Moreover, opening the gates quickly produces no immediate corresponding increase in power output but merely decreases the pressure in the conduit while the water column is being accelerated. The pressure drop may or may not produce a serious vacuum in some part of the conduit, depending of course on the profile and the hydraulic gradient.

If then the rate of movement of the turbine gates is restricted to a point where the pressure variations are hydraulically permissible, the movement is usually so slow as to be unsatisfactory for speed regulation. Moreover, what pressure variation does occur is always such as to oppose the desired change in turbine output. Increasing the diameter of the closed conduit will decrease the water velocity and the kinetic energy, and increasing the flywheel effect or moment of inertia of the rotating parts will make the speed fluctuations less severe, but a satisfactory solution along these lines only is usually impractical or uneconomic.

One device that goes to the heart of the problem is the surge tank, located as near the powerhouse as topography will permit. In this case, the energy in the line upstream from the surge tank is changed slowly, as the elevation in the tank changes, while relatively rapid changes in the flow of the shorter downstream line can be obtained without excessive pressure fluctuations. As a rough approximation, it may be stated that if the length of the line from the surge tank to the turbine is less than three times the head, satisfactory regulation can be obtained with reasonable values of pressure rise, penstock velocity and flywheel effect.

At Ixtapantongo, the topography is such that the surge tank is located at a point in the tunnel. Down-



TURBINE casing, servomotors, operating ring, guide vanes and bearing are shop assembled. Servomotor ports are blocked to permit operation and pressure testing of cylinders.

stream from the tank the conduit consists of 425 ft of tunnel, 285 ft of pipeline and 3,440 ft of individual penstock.

To lessen the difficulties imposed by this length of conduit, a relief valve was installed in the powerhouse. This device is essentially a bypass valve, opened and closed by the turbine servomotors, taking water from the turbine casing and discharging to the tailrace. Such a valve can be arranged to open when the turbine gates close and vice versa, which will result in the penstock flow remaining unchanged, an ideal condition in so far as speed regulation is concerned. This arrangement is frequently used in combined power and irrigation projects where a constant flow is required for irrigation purposes.

At Ixtapantongo the bypassed water would represent an intolerable loss of power, consequently the valve is so adjusted that it opens as the turbine gates close, but then recloses automatically at a slow rate. This arrangement permits the turbine gates to close rapidly following loss of electrical load with a negligible pressure rise, but it offers no assistance in regulating the speed drop when the load is increased.

Two factors tending to offset this apparently limited usefulness are: (1) In this plant, a considerable pressure drop can be tolerated; and (2) increases of load on a unit interconnected with others are almost always gradual or small, whereas full load may be lost instantaneously through a number of accidental causes, such as lightning disturbances on the transmission line.

It is obvious that the problems of speed and pressure regulation must be considered early in the study of a proposed development, and that their solution may have a decisive bearing on the final selection of plant location and layout.

The relief valve at Ixtapantongo is essentially an angle needle valve, hydraulically operated. As with all relief valves, absolutely reliable operation is paramount, because the safety of the entire installation hinges on its proper operation. It was designed and built by the Pelton Water Wheel Co., a subsidiary of the Baldwin Locomotive Works.

One feature of this installation which is rather unusual for a very high-head plant is the lack of an energy absorber below the relief valve. In many cases, it is necessary to insert such a device between the valve and the tailrace to reduce the high velocity of the discharge. In this plant, however, a steel pipe embedded in the powerhouse concrete carries the discharge to the tailrace well below the water surface. While the relief valve discharge causes a great deal of turbulence, no serious erosion has resulted. The discharge pipe is vented to the atmosphere just below the relief valve, permitting the intake of air to lessen the tendency of the high-velocity jet to cause vibration and cavitation.

Located immediately upstream of the turbine casing intake is the butterfly valve. Its primary functions are to permit inspection and repair of the turbine without draining the penstock and to save water if the unit is to be shut down for some time. Leakage through the valve can be held to 10 gal per min, which is much less than that through the turbine gates. The valve can also be used to shut down the turbine in an emergency.

Plant in Good Condition After Four Years

How well the first turbine fulfilled expectations in spite of construction during wartime scarcity and operation under the rigors of a power shortage became evident when it was shut down for the first time for maintenance after about four years of operation. The Comision engaged the services of an American firm, Welding Engineers, Inc., specialists in hydraulic turbine repair, to perform the welding while the Comision handled the dismantling and reassembly. Repairs were required on the runner and cap, guide vanes, wearing plates above and below the guide vanes and throat ring below the runner.

Pitting on the runner occurred on the lower half of the vanes downstream from the orifices, as shown in a photograph. Repairs were made by a combination of stainless steel plate and resurfacing with stainless welding rod, both having a composition of approximately 18 percent chromium and 8 percent nickel. Repairs were also made on the bottom face of the band. Inflow edges of the vanes were dressed up but there was no severe pitting on the backs of the vanes adjacent to the band as observed in many runners. Pitting around the vent holes through the crown extended down on the cap, which required some building up with stainless weld.

Repairs to Throat Ring and Guide Vanes

In the replaceable throat ring below the runner, a band of pitting extended down from the top face 4 to 6 in. Below this point the surface was in excellent condition on the throat ring and steel draft-tube section as well as on the concrete. Stainless steel repairs were made to the throat ring, and the Comision has obtained a stainless steel ring as a spare.

The guide vanes were damaged at the contact edges and on the upper and lower faces, but the stems were in good condition, as seen in a photograph. A spare set of cast stainless-steel guide vanes is held in reserve.

Resurfacing of the wearing plates above and below the guide vanes by stainless steel weld was preferred to replacement with spare plates from the standpoint of economy and future life as well as outage time. The heavy plates initially provided made this resurfacing practical.

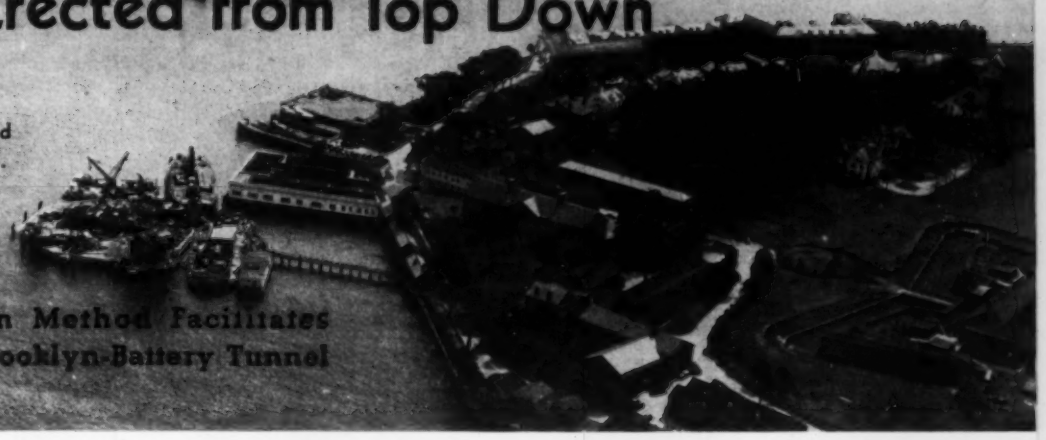
Protection of surfaces subject to cavitation with stainless steel is common practice in hydraulic turbines. A layer $^1/_8$ in. thick, applied by electric welding and hand ground to a smooth contour, has been found very satisfactory. Experience indicates that surfaces so protected will outlast ordinary cast or plate steel many times.

At reassembly new stationary wearing rings were installed as it was found that $^1/_{64}$ in. of wear had occurred on the hard brass inserts. The guide-vane bushings, runner seal ring, main bearing and stuffing box sleeve were all found to be in good condition.

When the turbine had been reassembled, the traditional final operating test of balancing an up-ended coin on the head cover was made and attested to the excellence of the repair and assembly job.

Steel for Tunnel Ventilating Shaft Is Erected from Top Down

RALPH SMILLIE, M. ASCE
Chief Engineer, Triborough Bridge and Tunnel Authority, New York, N. Y.



Unusual Construction Method Facilitates Work on New York's Brooklyn-Battery Tunnel

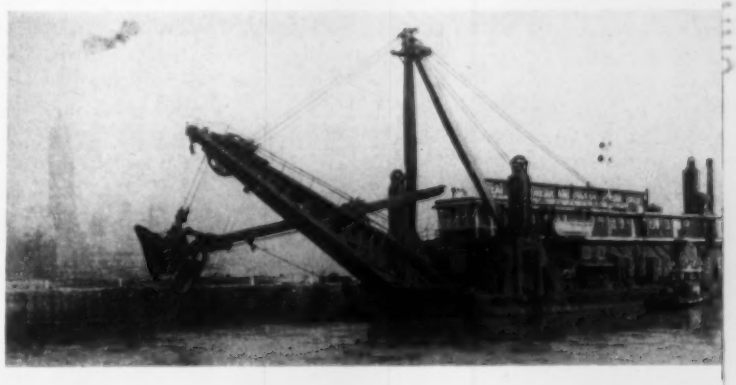
AN UNUSUAL if not unique method of caisson construction was adopted by the contractor who built the ventilating shaft for the Brooklyn-Battery Tunnel, which crosses under the East River to connect the southern tip of Manhattan Island with the Borough of Brooklyn. This ventilating shaft is located in the river at a point where the tunnel is 115 ft below mean high water, just off the northeastern end of Governors Island. The shaft, about midway of the tunnel length, will house ventilation fans and equipment to supplement other ventilating equipment located at the Manhattan and Brooklyn ends of the tunnel. The sand island method was used for sinking the ventilating-shaft caisson, but before excavation was completed, the contractor began hanging the permanent steel for the shaft from the cutting edge of the caisson. Because of the limited area of the sand island, most of the construction equipment was set up on barges.

CONSTRUCTION of the Governors Island ventilating shaft for the Brooklyn-Battery Tunnel in New York City included the building of an artificial island to protect the structure, the sinking of a caisson 51 × 111 ft for a depth of about 80 ft to ledge rock, the excavation of a rock shaft in the open below the caisson to a total depth of 140 ft, the placing of structural steel and concrete lining, and interior construction within the shaft.

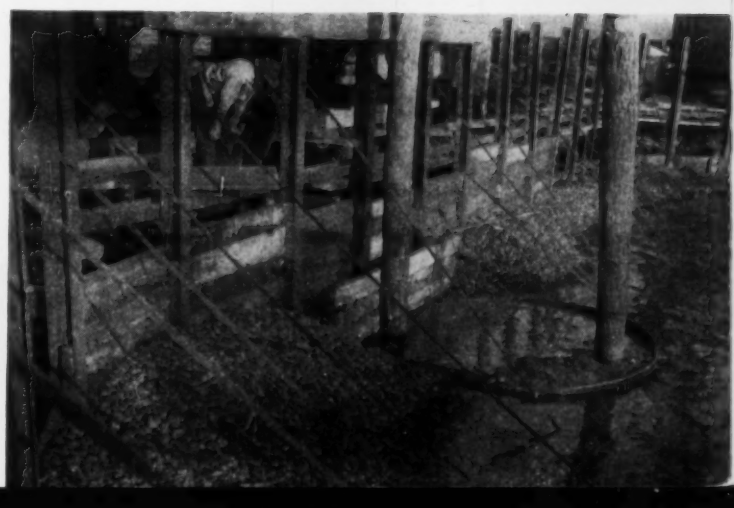
At the shaft location, near Governors Island, the tunnels are at their deepest point, the roadway being 115 ft below mean high water. The depth of water is about 20 ft. The river bottom consists of soft mud overlying silt and glacial till over Manhattan schist. Rock is encountered about 75 ft below mean high water. The contractor had the choice of building the caisson on shipways and floating it to the site, or of building the protective island first and sinking the caisson from its surface. He elected to use the second method.

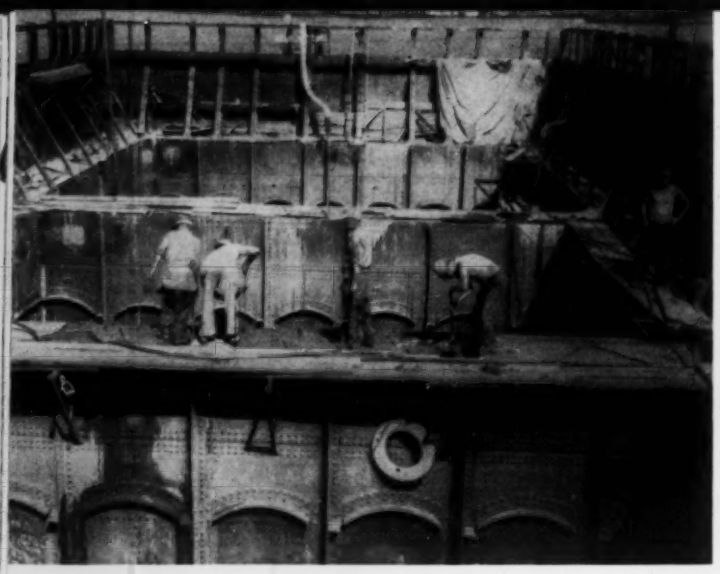
Dredging Precedes Sand Island Construction

The first operation was to dredge to a depth of about 55 ft so as to remove the greater part of the glacial till and boulders that were expected

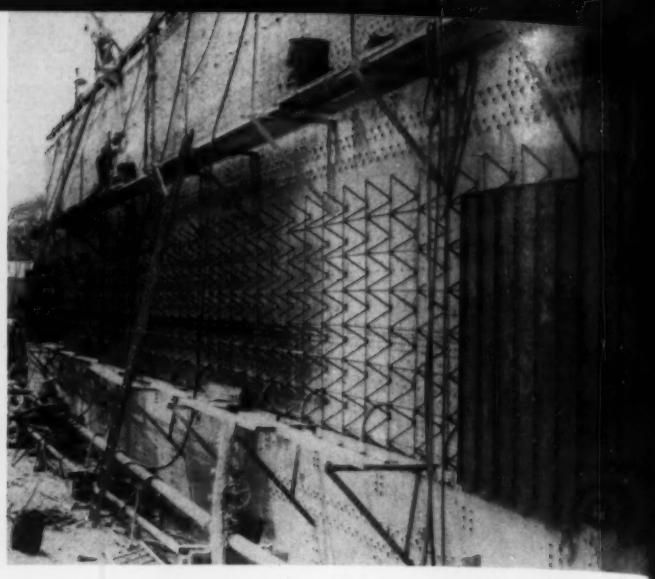


DIPPER DREDGE (at right) removed greater part of glacial till and boulders which were expected to give trouble in sinking caisson and intake structure foundation cylinders for Governors Island ventilating shaft of Brooklyn-Battery Tunnel. Crane (below) operates dragline to place sand fill for island. Steel piles with horizontal wood sheeting (lower right) retain upper part of sand fill for island before completion of bulkhead wall.





CONCRETE-FILLED cross walls divide caisson into three compartments, two providing space for air ducts and one containing stairwell and elevator shaft. Risers for jets along cutting edge can be seen inside of caisson walls.



VERTICAL BAR TRUSSES welded to skin plates anchor 18-in. protective concrete layer to caisson. Lower 50 ft of caisson is 6 ft $6^7/_8$ in. thick, above which caisson wall is stepped in 18 in. to receive protective concrete.

to give trouble in the sinking of the caisson and the foundation cylinders. The river mud, about 10 ft thick, was removed with a 5-cu yd clamshell bucket and the remaining material, consisting of sand, clay, gravel and boulders to the 55-ft depth, was removed with a dipper dredge having a 10-cu yd bucket. About 40,000-cu yd of material was dredged before the island was started. A 10-ft layer of clay was then placed over and outside of the shaft area to facilitate sinking of the shaft and to provide an impervious seal for the caisson which, it was anticipated, would permit the entire sinking operation to be done without the use of compressed air. The remainder of the dredged area was then filled to the elevation of the original river bottom with sand fill, much of it being ship ballast from abroad.

Piles Driven Through Fill

For the fender structure, wharf and breakwater, a total of 1,149 creosoted timber piles were driven through the fill into the original material. Riprap was placed between these piles to the elevation of the bottom of the future relieving platform to retain the sand fill of the island proper. As the contractor was not ready at this time to complete the bulkhead wall, he erected a ring of eighty-eight 8-in. 24-lb H-sections, placed vertically 6 ft on centers around the inner perimeter of the relieving platform. Horizontal wood sheeting placed between these beams formed a temporary bulkhead wall that enabled the fill of the island to be brought up above high water.

The caisson is of conventional design with walls consisting of inner and outer steel skin plates, braced by steel trusses and filled with concrete. A single skin plate braced with structural steel was used for the top 8 ft. For the lower 50 ft, the exterior walls are 6 ft $6^7/_8$ in. thick out-to-out of skin plates. Above this level the outer skin plates are stepped in 18 in., making room for a protective layer of concrete 18 in. thick, anchored with vertical bar trusses welded to the skin plates. The caisson is divided into three wells by 4-ft-thick cross walls. The two outer wells provide space for air ducts to the tunnel, and the center well contains a stairwell and an elevator shaft. The rock portion of the shaft below the cutting edge of the caisson is braced with steel girders embedded in concrete.

As the ventilation building is octagonal in plan, the protective island was also made octagonal, but enough larger to allow for a strip 35 ft wide all around the building. The island itself, outside of the shaft area, is sand fill retained by a riprap embankment, surmounted by a granite-faced concrete sea wall built on a reinforced concrete relieving platform supported on timber piles. As the building is considerably larger than the caisson, separate supports had to be provided for the outer periphery. These supports are eight 5-ft 6-in.-dia concrete-filled steel shell cylinders sunk to rock. The concrete cylinders were carried below the rock surface to concrete footings previously constructed in side drifts carried out from the tunnel excavation.

Caisson Steel Erected at Site

Structural steel for the caisson was erected at the site. The cutting edge was at first supported on twenty-four 200-ton wedge jacks so that it could be accurately leveled. After the lower 20 ft of the caisson had been erected and riveted, the cutting edge was lowered to the filled surface of the island. Sinking operations were then started and additional steel and concrete placed as the caisson sank. As erection progressed the joints between sections of the skin plate, both on the inside and outside of the caisson, were seal-welded to provide watertight joints and hose-tested for leakage with a stream of water at 200-psi pressure. Steel erection and concreting operations were carried on during the day shift only. Excavation was carried on during both night shifts. The total weight of the caisson was 12,750 tons, made up of 2,013 tons of steel and 5,300 cu yd of concrete.

The caisson was sunk 66 ft below the island surface by open dredging using two stiff-legged derricks with 120-ft booms and $1^1/_2$-cu yd clamshell buckets. Sinking operations were facilitated by a series of jets on the inside of the caisson, located near the cutting edge. A total of sixty-four $^5/_8$-in. nozzles were connected in groups to headers which permitted separate operation of any desired group. Water jets were supplied at

CUTTING EDGE of caisson is fitted with jets to facilitate sinking operations. Jet installation runs along cutting-edge bracket.

200-lb. pressure by four 4-in., 400-gpm centrifugal pumps operated in pairs in tandem. In addition to the fixed jets, 8-in. riser pipes were provided at the four corners of the caisson through which portable jets could be lowered.

Jetting at random locations was also done with a combination 4-in. jet pipe and an 8-in. air lift handled by a derrick. The primary purpose of the jetting system was to loosen up material under the caisson walls in locations that could not be reached with a clamshell bucket. Progress in sand was 0.67 ft per day; in the clay layer, 0.60 ft per day; and in the glacial till, 0.41 ft per day; or a total of 65 ft in 94 working days.

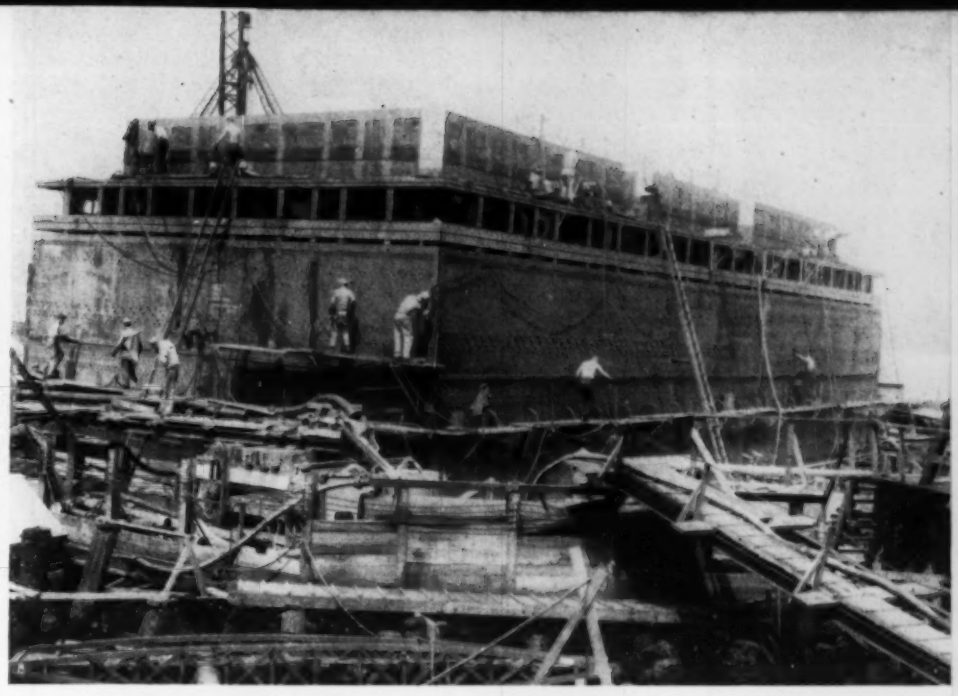
Compressed Air Found Necessary

When the caisson had been sunk 66 ft below the surface of the island, further progress by open dredging was found to be impractical and the caisson was pumped down with the hope that excavation could be completed under normal air. As material started to come into the caisson under the cutting edge, this operation was abandoned and an air roof was placed near the top of the caisson. The rest of the excavation, both in earth and in rock, was carried on under compressed air on a 24-hour-a-day basis until the cutting edge reached the designated depth of 77 ft below mean high water. The maximum air pressure was 25½ psi.

During compressed-air work the roof of the caisson was loaded with muck, increasing the total weight of the caisson to about 18,000 tons. The estimated skin friction during drops varied from 600 to 700 lb per sq ft. At its final elevation, the cutting edge was an average of 7 ft below the rock surface. At one corner, however, the rock dropped off steeply to about 3 ft below the cutting edge. At this corner excavation was continued under compressed air to a depth of 7½ ft below the cutting edge, at which point test holes showed satisfactory rock outside of the caisson area. A reinforced concrete wall 2 ft thick was then built around this area to underpin the corner of the caisson where the rock was low.

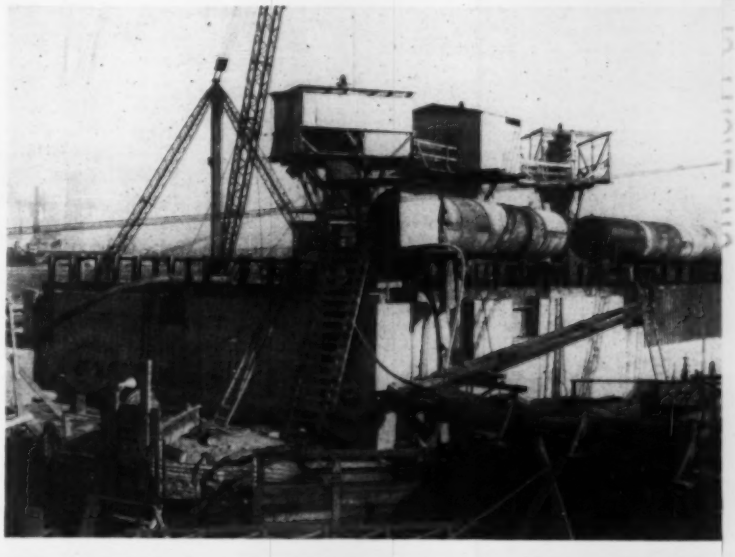
Caisson Sealed to Rock

A grout collar was then placed around the entire cutting edge and the caisson sealed to the rock. Upon completion of the seal, the air roof was removed and rock excavation below the cutting edge continued in free air. In this manner 8,300 cu yd of rock were removed and the shaft



STEEL SECTIONS of caisson are delivered by barge and placed by crane. In view, next to top truss of caisson is in place, making height above cutting edge about 69 ft. Footbridge connecting with old ferry used to house powerplant appears in right foreground. At this stage cofferdam is being lowered in free air.

completed to a total depth of 140 ft. As the rock tunnels below the caisson had already been excavated under another contract, the procedure was to break through to each of the tunnels with a small excavation through which excavated material from above was dropped. Muck was loaded into 5-cu yd battleship buckets by one of the derricks, using a clamshell. The buckets then were loaded onto scows moored alongside the island. As an added measure of safety, the contractor elected to erect the permanent steel for the shaft from the top down as excavation progressed. To accomplish this, hangers were welded to the caisson brackets. The permanent steel was then erected in subassemblies on the surface and hung from the brackets on the cutting edge. Construction continued on a three-shift basis—steel erection and rock drilling occupying the day shift, and rock excavation the two night shifts. When excavation and steel erection were



MUCK LOCKS AND MAN LOCKS (horizontal) installed along top of caisson permit continuation of excavation under compressed air (upper view). Because of restricted area of sand island, diesel compressors (lower view) are installed on old ferry moored off side of island.

PERMANENT STEEL for ventilating shaft is hung from cutting edge of caisson as excavation continues (upper view). Upon completion of excavation, invert was poured and concrete was placed between steel members of vertical walls. Junction of ventilation shaft and Brooklyn-Battery Tunnel is shown in lower view.

complete, the reinforced concrete invert was poured and concrete placed between the steel members of the vertical walls of the shaft.

Steel Cylinders Driven to Rock

To support the ventilation building outside of the caisson area, eight 5-ft 6-in.-dia steel cylinders of $^1/_2$-in. material, stiffened internally with 3 × 3-in. circumferential angles, were driven to rock or to refusal near rock. Each cylinder was made up of four 20-ft lengths set up in 40-ft sections and driven with a double-acting steam hammer. To distribute the hammer blow, 4-in. steel billet plates were placed on top of the cylinders. These 4-in. billets proved inadequate and were later replaced by 6-in. billets. The cylinders were alternately mucked and driven down to their final position. Mucking was accomplished by means of a water jet and air lift supplemented by a chopper where a hard material was encountered. The steel cylinders were driven to an average depth of 71 ft below mean high water.

Dewatering of the cylinders was found to be impracticable because of inflow of material at the bottom and it was necessary to install air locks and carry the excavation into rock under compressed air. The cylinders were sealed into rock to insure against inflow of water or soft ground during the subsequent work of excavation through rock to the concrete footings already placed in drifts from the tunnel excavation. This seal was accomplished by using liner plates made up of 4-in. channels shop-fabricated to the proper radius. The first ring was placed near the bottom of the steel cylinders and subsequent rings added as excavation progressed. The plates were provided with grout holes and grouted to rock. After the seal had been completed, the remaining rock excavation was completed in free air. During the rock excavation, water was drained out through drill holes in the bottom of the shaft into the tunnel, instead of being permitted to accumulate at the bottom of the shaft where it would have been difficult to pump out.

Concrete Plant Located on Dock

The contractor's plant included two 35-ton stiff-legged derricks, with 120-ft booms, supported on concrete-capped pile foundations located on opposite sides of the caisson. These derricks could reach the greater part of the island. The concrete plant, consisting of a 1,500-bbl cement storage bin and sand and gravel hoppers, was located on a dock supported on piles adjacent to the island.

Because of the restricted area of the island itself, the contractor used floating equipment for the greater part of his plant. An old ferry boat, moored off the southerly side of the island, was used for compressor plant, electric power generation, machine shop and facilities for the men. Two deck scows and another old ferry boat with the superstructure removed were used for office, storage and general purposes.

Builders and Operators of Tunnel

On completion, the Brooklyn-Battery Tunnel will be operated by its builders, the Triborough Bridge and Tunnel Authority. Members of the Authority are Robert Moses, Chairman; George V. McLaughlin and Charles G. Meyer, Vice-Chairman. George E. Spargo is General Manager and Secretary. The writer is Chief Engineer.

The contract for the Governors Island shaft and artificial island was carried out by the Grow Construction Co., Inc., Charles Goodman, M. ASCE, president. The interior concrete work in the shaft was finished by Mason & Hanger Co., Inc., Miles I. Killmer, M. ASCE, Vice-President.

TO LEARN how to make a good speach, attend a typical engineering society meeting. Note just how papers are presented. Then go thou and do otherwise.

DESPITE the old adage, don't be afraid to be a "jack of all trades." The modern world needs more of them to tie together the little cells in which the specialists live. Practical versatility is a rare and valuable quality.

—Philip W. Swain, Editor of *Power*

BATAAN-CORREGIDOR MEMORIAL BRIDGE is designed to carry heaviest vehicles expected for years to come. Design provides for continuous line of 50-ton street cars adjacent to center truss in each direction plus live load of 125 lb per sq ft on each 36-ft roadway and 100 lb on each sidewalk. Over-all width of 108 ft represents great increase over predecessor, which was 62 ft wide. Floor is concrete-filled steel grid for long life and sidewalks are $^3/_4$-in.-thick asphalt plank, fastened to timber planking.

MACHINERY GEAR TRAIN (two to each leaf) is driven by 75-hp, 600-v, d-c motor which lifts leaf through 72 deg in 45 sec. Each motor operates through open-type gear train terminating in pinion engaging gear rack attached to outside leaf truss. Gear ratio from motor to bascule leaf is 2,400:1; that is, motor makes 480 revolutions to complete lift.

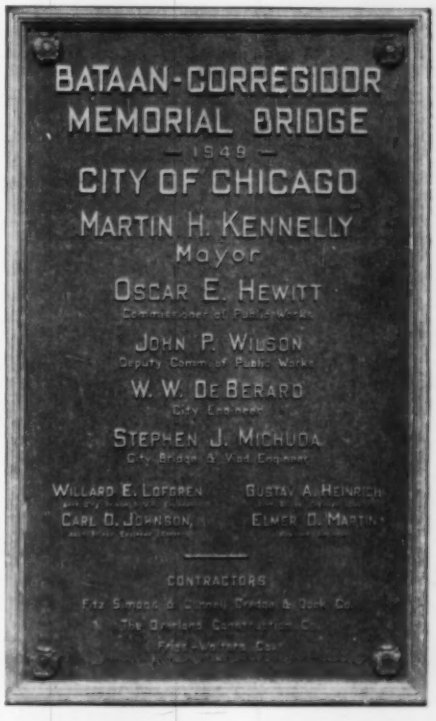
Chicago's Newest and Heaviest Bascule

IMPROVED CONDITIONS for both navigation and street traffic have been secured by completion of the new double-leaf trunnion bascule at the site of Chicago's old North State Street Bridge. The new clearance over the river, of 20 ft for a width of 103 ft and $16^1/_2$ ft for 160-ft width permits free passage of tugs and barges without opening the bridge and interrupting heavy street traffic. This $3,000,000 span was recently dedicated as the Bataan-Corregidor Memorial Bridge in honor of Chicago's sons who took part in these historic actions.

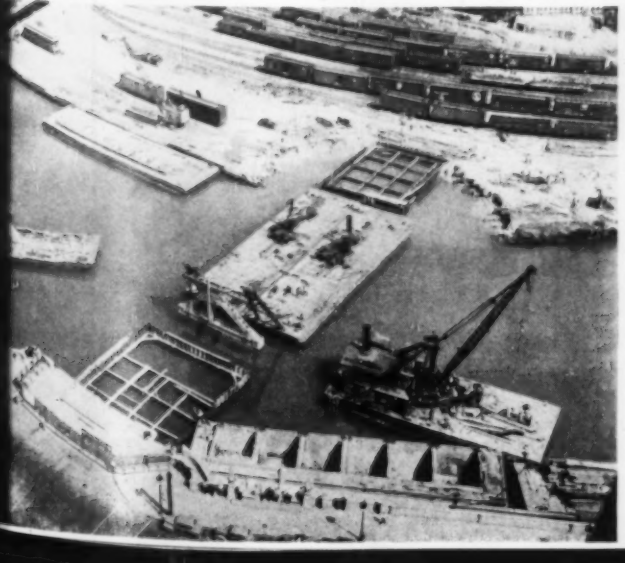
This bridge is one of the 56 movable and 22 fixed bridges which have been built over the city's 35 miles of navigable waterways by Chicago's Bureau of Engineering.

Pits into which counterweights swing down when the bridge is opened are concrete boxes each resting on six caissons. The pits were built in the dry inside cofferdams. To bridge the load of each leaf over the two tubes of the North State Street subway, a 75-ton steel truss in the river wall of each pit was positioned on top of the river caissons by divers. Inside cofferdam bracing, removed for truss placement, had to be reset to permit unwatering of cofferdams.

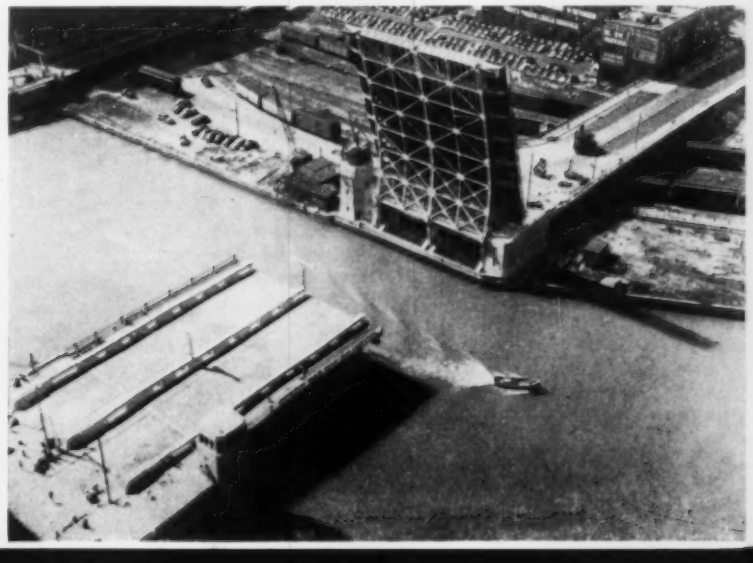
Construction of the bridge had to await completion of the subway. After a year of work the bridge foundations were finished in 1942, when further work was stopped by order of the War Production Board. The first superstructure steel was finally delivered late in 1947. Erection of the superstructure and approach viaducts required a few days less than two years. The bridge was dedicated May 28, 1949.



BARGE DELIVERS 75-ton truss for placement by divers in south cofferdam to carry weight of bascule leaf over twin subway tubes. Truss bears on caissons founded on bedrock 103 ft below water level. See phantom view at top left.



BASCULE LEAF weighing 3,250 tons swings up on its three trunnions. Clear span is 210 ft. Clearance of 20 ft for 103-ft width permits passage of river barges without opening bridge. Old bridge clearance was $16^1/_2$ ft for barely 50-ft width.



Engineers' Notebook

Drive-In Bank Does Brisk Business in Houston, Tex.

CYRIL S. ADAMS, M. ASCE
Consulting Engineer, Houston, Tex.

A NOVEL STEP to permit "business as usual" in spite of increasing traffic congestion in downtown Houston, Tex., has been taken by the Houston National Bank. This bank, located at the corner of Main Street and Franklin Avenue, is in the older part of the city, which is heavily built up with office buildings and banking establishments and virtually without passenger-car parking facilities. The few parallel-to-curb parking spaces permitted by city ordinance are needed for truck loading and unloading, and the few existing commercial parking lots, besides being costly, time-consuming, and inconveniently located, are also filled to overflowing with the cars of those who work in the area.

The ever-increasing parking difficulty, along with a decided tendency for personal banking to shift to surburban areas for convenience, led the Houston National Bank to acquire and demolish two two-story masonry buildings on Franklin Avenue, adjoining the bank's property on the rear. The two buildings together had a frontage of 62 ft 4 in., a minimum depth of 100 ft, and a market value of $60,000.

A plan was developed to use the area thus created for two purposes—a customer drive-in bank and a parking space for the use of customers who must go inside the bank for the proper transaction of their business.

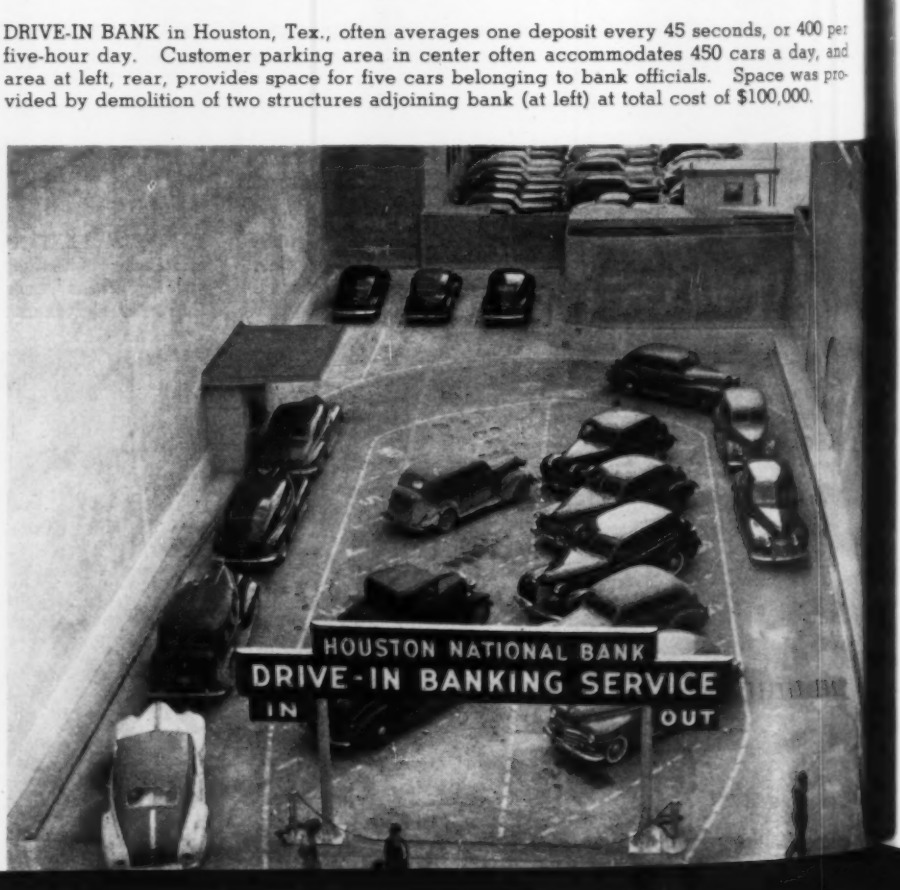
For the first service, a "drive-in" teller's window was built through the rear wall of the present bank building (dating from 1929) so that the teller could have complete access to all vaults and departments, just like an inside teller. It was physically possible to project a small reinforced-concrete booth through the rear brick wall of the bank building and tie the new structure to the existing reinforced-concrete frame. It was also possible to extend the air-conditioning, electric, and inter-communications systems to the new booth. A bullet-resistant stainless-steel bay-window type of teller's wicket was installed. The arrangement was made to fit the specific needs of the bank. A sliding deal tray at car-window height was placed in the unit for receiving normal deposits, cashing checks, issuing statements, and other operations involving small objects. An interlocked package-receiver, 12×12×8 in., was also placed at car-window height for handling payrolls, bulky deposits, etc. This arrangement provides the same accommodations as an inside teller's wicket.

The would-be bank customer approaching the building in a passenger vehicle or small truck drives southeast on Franklin Avenue in the normal traffic stream and turns right into the lane at the open-air bank. He stops at the wicket, places his entry book and deposit slip (previously prepared) in the sliding deal tray, and transacts his business while sitting in his car, talking with the teller in a normal tone of voice by means of an inter-communication set. His business finished, he makes a 180-deg turn to the right and proceeds along the exit lane to Franklin Avenue, where he makes a right turn and joins traffic in essentially the same position he was in before entering the banking area.

An automatic traffic signal protects pedestrians walking along Franklin Avenue. As each car travels down the exit lane the front wheels pass over a pneumatic tube placed flush with the concrete slab. An electrical relay changes the red neon traffic signal to "Don't Walk" from "Walk" and at the same time sounds a gong to attract attention. A timing device flashes the signal back to "Walk" after the car has passed.

The second service that the area affords is parking. The five parking spaces in the closed end of the property are normally used by officials of the bank, and the ten large parking spaces in the "island" are reserved for customers. The traffic attendant on duty in the area part of each day

DRIVE-IN BANK in Houston, Tex., often averages one deposit every 45 seconds, or 400 per five-hour day. Customer parking area in center often accommodates 450 cars a day, and area at left, rear, provides space for five cars belonging to bank officials. Space was provided by demolition of two structures adjoining bank (at left) at total cost of $100,000.



often permits 12 cars to park in the ten large parking spaces.

The two structures demolished to create the parking area were without basements and had high ground floors in earth, 4 ft above the invert of the gutter, so that it was necessary to grade the area to match the street level for access and surface drainage after protecting the surrounding buildings (other than the bank building) against settlement. This protection was provided in the form of a steel sheetpile cutoff wall to serve as a retaining wall where the difference in grade occurred between the parking area and the contiguous structures. After final grading, slab surfaces were poured over the area and marked for use. The teller's booth has a reinforced-concrete cantilever roof to protect papers from rain, but there is no roof over the rest of the drive-in area.

This drive-in bank has now been in operation for more than a year, and the operation of the two services—drive-in bank and customer parking—has been highly successful. The wicket often averages a deposit every 45 seconds, so that in a busy 5-hour banking day the teller may handle 400 deposits. The ten in-and-out parking spaces often accommodate 450 cars a day. These advantages far outweigh the cost of $60,000 for property and $40,000 for construction—a total investment of $100,000.

Traffic police in the vicinity have noted a slight improvement in the general traffic situation since the drive-in facilities opened. They believe that formerly many bank customers brought along friends to drive around the block while they conducted their banking business. This type of traffic, which is slow-moving in order to consume time, has now been eliminated in the vicinity of the bank.

President of the Houston National Bank is Joseph F. Meyer, Jr., whose forethought led the way to this improvement, first of its type in this community. Construction was done by the Knutson Construction Co., of Houston. The writer served as consulting engineer, prepared plans and specifications, and supervised demolition and construction.

Open and Closed Channels Designed by Short-Cut Method

FRANCIS BATES, M. ASCE
City Engineer, Vernon, Calif.

PROBABLY EVERYONE working with hydraulic problems eventually acquires his favorite "dimensionless constant" which he preserves in a form most useful to his particular type of work. Phillip Z. Kirpich, Assoc. M. ASCE, has discussed his favorites for use with open channels of trapezoidal and rectangular cross sections, and has presented useful curves for quickly solving many types of flow problems ("Dimensionless Constants for Hydraulic Elements of Open-Channel Cross Sections," CIVIL ENGINEERING for October 1948). The writer has long used a dimensionless constant which is of similar derivation, but of somewhat wider scope than the conveyance symbol K, used by Mr. Kirpich.

Values for the writer's factor K may be compiled for any combination of geometrical shape of cross section, relative depth and roughness coefficient n, for either open or closed channels. These values may be used in the direct calculation of flow problems. The necessary data for quickly determining this "constant," together with a table of values for K (Table II), which covers quite a wide range of possible channel conditions, are given herein.

Mr. Kirpich's symbols are used (Table I), except as follows: A dimensionless ratio, $X = \frac{b}{y} = \frac{1}{a}$; and, ϕ being the side-slope angle (with the horizontal), $\tan \phi = \frac{1}{s}$; $\sin \phi = \frac{1}{s'}$. Also S indicates the fall in feet per thousand, rather than "slope of energy grade line." A new factor, B, is introduced which is the ratio of the hydraulic radius to the wetted perimeter. That is,

$$B = \frac{R}{p} = \frac{A}{p^2} \quad . \quad . \quad . \quad (14)^*$$

That portion of the flow equation to be represented by K is derived as follows: Substituting Bp for R, in the Manning form of the Chezy formula,

$$V = \frac{1.4858 B^{2/3} p^{2/3} S^{1/2}}{n(10)^{3/2}} \quad . \quad . \quad . \quad (15)$$

And, since $A = Bp^2$,

$$AV = Q = \frac{1.4858 B^{2/3} p^{8/3} S^{1/2}}{n(10)^{3/2}} \quad . \quad (16)$$

Whence, eliminating p from Eqs. 15 and 16,

$$Q = \frac{(10)^{3/2} n^3 V^4}{(1.4858)^3 BS^{3/2}} \quad . \quad . \quad . \quad (17)$$

$$V = \frac{(1.4858)^{3/4} B^{1/4} S^{3/8} Q^{1/4}}{n^{3/4} (10)^{3/8}} = K S^{3/8} Q^{1/4} \quad . \quad (18)$$

And

$$Q = K^{4/3} A^{4/3} S^{1/2} \quad . \quad . \quad . \quad . \quad (19)$$

The value of B may be found directly for a channel of known dimensions or, for the present purpose, in terms of the dimensionless ratio X (bottom width to depth) and shape of cross section. The more usual forms of conduit encountered are as follows:

Circular, full, $B = \frac{1}{4\pi}$ . . . . . (20)

Semicircular, open, $B = \frac{1}{2\pi}$ . . . . . (21)

Semicircular, closed, $B = \frac{\pi}{2(2+\pi)^2}$. (22)

Rectangular, open, $B = \frac{X}{(2+X)^2}$ . . (23)

Rectangular, closed, $B = \frac{X}{(2+2X)^2}$. (24)

V-section, open, $B = \frac{(\sin \phi)^2}{4 \tan \phi}$ . . . . (25)

Trapezoidal, open, $B = \frac{X + \frac{1}{\tan \phi}}{\left(X + \frac{2}{\sin \phi}\right)^2}$ (26)

Trapezoidal, closed, $B =$

$$\frac{1 + \frac{1}{X \tan \phi}}{4X\left(1 + \frac{1}{X \tan \phi} + \frac{1}{X \sin \phi}\right)^2} \quad . \quad (27)$$

The factor K has been found very useful, especially in Eq. 18, by which the velocity can be determined quickly without first getting the dimensions of the channel. The work is made even more simple if a table of the $^3/_8$ power of numbers is available. Also, the relative effect of each velocity-controlling characteristic of the channel is immediately discernible to the eye, being directly proportional to the values of K.

A somewhat similar dimensionless constant (called F) was used some years ago by R. L. Gregory and C. E. Arnold, Associate Members, ASCE, in their paper, "Runoff-Rational Runoff Formulas" (TRANSACTIONS, Vol. 96 (1932), page 1038). They made fine use of this idea and included a tabulation of "Values of Factor F" which they had compiled from studies of published

* Equations are numbered beginning at 14, to continue Mr. Kirpich's sequence of equations, which were numbered 1–13, inclusive.

hydraulic tables rather than from calculations by a formula. Nevertheless, they could have saved themselves considerable work and arrived at exactly the same results if they had made use of the equation:

$$F = K^{1/2}(10)^{3/4} = \frac{(1.4858)^{3/8}(10)^{3/16}B^{1/8}}{n^{3/8}} = \frac{1.7865\,B^{1/8}}{n^{3/8}} \quad (28)$$

The writer acknowledges a debt to Messrs. Gregory and Arnold for their original conception, which aroused his interest and led to the writing of the equation for the specialized form, F, and later to the broader form of factor K.

TABLE I. NOTATION USED IN FORMULAS

A = area	n = roughness coefficient in Manning's formula	R = hydraulic radius	S = slope of energy grade line (friction slope)	y = depth of flow	y_c = depth of flow for critical discharge
b = bottom width	n_B = the hydraulic exponent	s = side slope of trapezoidal channel (1 vertical on s horizontal)	s' = length of side slope of trapezoidal channel ($\sqrt{1+s^2}$)	y_n = depth of uniform flow	α = depth - width ratio = y/b
b_w = top width	p = wetted perimeter				
C = coefficient in Chezy formula	Q = discharge				σ = critical slope
g = acceleration of gravity	Q_0 = discharge for uniform flow		S_0 = slope of channel bed		
K = conveyance	Q_c = discharge at critical depth				
K_0 = conveyance for uniform flow					
$K_M = 1.486/n$					

TABLE II. VALUES FOR K

$$\text{Velocity, } V = \frac{(1.4858)^{3/4}B^{1/4}S^{3/8}Q^{1/4}}{(10)^{9/8}n^{3/4}} = KS^{3/8}Q^{1/4}$$

Kutter's n				0.011	0.013	0.015	0.020	0.025	0.030	0.035	0.100
$1 \div n^{3/4}$				29.441	25.974	23.331	18.803	15.905	13.873	12.358	5.625
$(1.4858^{3/4} \div (10)^{9/8}n^{3/4}$				2.971	2.621	2.355	1.898	1.605	1.400	1.247	0.568
	X	$\div B$	$B^{1/4}$								
Circular Closed Sections											
Pipe	...	0.0796	0.5311	1.578	1.392	1.251	1.008	0.853	0.744	0.662	
Semicirc.	...	0.0594	0.4937	1.467	1.294	1.163	0.937	0.792	0.691	0.616	
Rectangular Closed Sections											
Single	0.5	0.0556	0.4855	1.442	1.273	1.143	0.921	0.779	0.680	0.605	
	1	0.0625	0.5000	1.486	1.311	1.177	0.949	0.803	0.700	0.624	
	2	0.0556	0.4855	1.442	1.273	1.143	0.921	0.779	0.680	0.605	
	3	0.0469	0.4653	1.382	1.220	1.096	0.883	0.747	0.651	0.580	
	4	0.0400	0.4472	1.329	1.172	1.053	0.849	0.718	0.626	0.558	
Double	0.5	0.0278	0.4082	1.213	1.070	0.961	0.775	0.655	0.572	0.509	
	1	0.0312	0.4204	1.249	1.102	0.990	0.798	0.675	0.589	0.524	
	2	0.0278	0.4082	1.213	1.070	0.961	0.775	0.655	0.572	0.509	
	3	0.0234	0.3913	1.163	1.026	0.921	0.742	0.628	0.548	0.488	
Triple	0.5	0.0185	0.3689	1.096	0.967	0.869	0.700	0.592	0.516	0.460	
	1	0.0208	0.3799	1.129	0.996	0.895	0.721	0.610	0.532	0.474	
	2	0.0185	0.3689	1.096	0.967	0.869	0.700	0.592	0.516	0.460	
	3	0.0156	0.3536	1.060	0.927	0.832	0.671	0.568	0.495	0.441	
Semicircular Open Sections											
		0.1592	0.6316	1.877	1.656	1.487	1.199	1.014	0.884	0.788	0.358
Rectangular Open Sections											
Single	0.5	0.0800	0.5318	1.580	1.394	1.252	1.009	0.854	0.745	0.663	0.302
	1	0.1111	0.5773	1.715	1.513	1.359	1.096	0.927	0.808	0.720	0.328
	2	0.1250	0.5946	1.767	1.559	1.400	1.128	0.954	0.832	0.742	0.337
	3	0.1200	0.5886	1.749	1.543	1.386	1.117	0.945	0.824	0.734	0.334
	4	0.1111	0.5773	1.715	1.513	1.359	1.096	0.927	0.808	0.720	0.328
	6	0.0937	0.5533	1.644	1.459	1.303	1.050	0.888	0.775	0.690	0.314
	8	0.0800	0.5318	1.580	1.394	1.252	1.009	0.854	0.745	0.663	0.302
	10	0.0694	0.5133	1.525	1.346	1.209	0.974	0.824	0.719	0.640	0.291
	12	0.0612	0.4974	1.478	1.304	1.171	0.944	0.798	0.696	0.620	0.282
	20	0.0413	0.4509	1.340	1.182	1.062	0.856	0.724	0.631	0.562	0.256
	30	0.0293	0.4137	1.229	1.084	0.974	0.785	0.664	0.579	0.516	0.235
	100	0.0096	0.3131	0.930	0.821	0.737	0.594	0.503	0.438	0.390	0.178
Open Sections with Side Slopes											
1/2:1	V—Section	0.1000	0.5623	1.671	1.474	1.324	1.067	0.903	0.787	0.701	0.319
	1	0.1432	0.6152	1.828	1.613	1.448	1.167	0.987	0.861	0.767	0.349
	2	0.1393	0.6109	1.815	1.601	1.438	1.159	0.981	0.855	0.762	0.347
	4	0.1157	0.5832	1.733	1.529	1.373	1.107	0.936	0.817	0.727	0.331
	8	0.0811	0.5337	1.586	1.399	1.257	1.013	0.857	0.747	0.666	0.303
	16	0.0496	0.4720	1.402	1.237	1.111	0.896	0.758	0.661	0.589	0.268
	30	0.0294	0.4139	1.230	1.085	0.975	0.785	0.644	0.579	0.516	0.235
	100	0.0096	0.3131	0.930	0.821	0.737	0.594	0.503	0.438	0.391	0.178
1:1	V-Section	0.1250	0.5946	1.767	1.559	1.400	1.128	0.954	0.832	0.742	0.337
	1	0.1365	0.6078	1.806	1.593	1.431	1.153	0.976	0.851	0.758	0.345
	2	0.1287	0.5989	1.780	1.570	1.410	1.137	0.961	0.839	0.747	0.340
	4	0.1072	0.5722	1.700	1.500	1.347	1.086	0.919	0.801	0.714	0.325
	8	0.0768	0.5264	1.564	1.380	1.239	0.999	0.845	0.737	0.656	0.299
	16	0.0480	0.4680	1.390	1.227	1.102	0.888	0.751	0.655	0.584	0.266
	30	0.0288	0.4118	1.224	1.080	0.970	0.781	0.661	0.577	0.514	0.234
	100	0.0096	0.3126	0.929	0.819	0.736	0.593	0.502	0.438	0.390	0.177

Let: A = section area, in sq ft; R = hydraulic radius; P = wetted perimeter, in ft; S = fall, in ft per 1,000; Q = flow in cfs; V = velocity, in ft per sec; $B = R/P = \alpha/P^2$; X = ratio, bottom width to depth; ϕ = side-slope angle, with horizontal.

For any conduit having M identical sections, B value varies directly as $1/M$, from that for the single section.

... THE READERS Write

Standard Procedure for Log Logs Recommended

DEAR SIR: Other engineers may share the writer's yen for a standard routine in handling log log x, which includes the special case where x lies between plus and minus 1.0, and notably when the operation is reversed. The accompanying example, giving procedure for the general case, aims to satisfy this need. Its self-evident magnitudes will permit visual checking.

The textbooks seem to ignore an apparent ambiguity in the special case, which arises from the calculator's habitual dependence on the tabular rather than the real form of a seminegative log.

To find any log log x, log x either is, or must be, unconventionalized so as to form an argument whose characteristic and mantissa both have the same sign (here negative). By noting that log x = (−colog x) the conversion is readily effected.

As in all "logging" operations, a fully negative log x is treated as a positive argument, the frontal minus sign being restored when the operation is reversed. This procedure of course does not determine the proper sign for the objective function of x (here x^2) which is found in the usual way from the nature of each problem.

F. T. LLEWELLYN, M. ASCE
Baton Rouge, La.

PROCEDURE FOR HANDLING LOG LOGS

PROBLEM: By Log Logs to find x^2, when $x = (-0.25)$

QUANTITY		COMMON LOGARITHMS (Rounded from 7-place tables)	
Symbol	Magnitude	Log	Log Log
		$T = 9.39794 - 10$	
		$= -\text{colog } x$	
x	-0.25	$= N = -(0.60206) = A$	$9.77964 - 10$
Index	2	Multiply by $(2 = A)$	(0.30103)
		$N = -(1.20412) = A$	0.08067
		$= -\text{colog } x^2$	
x^2	0.0625	$= T = 8.79588 - 10$	

Meaning and Use of Symbols

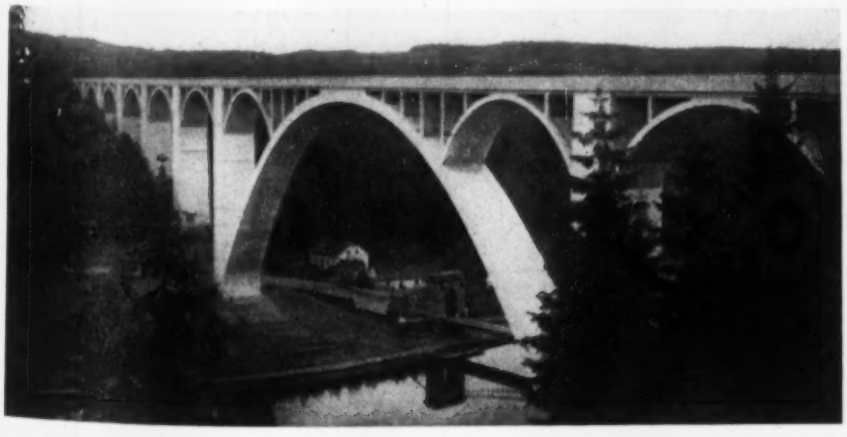
A = Argument (fully positive or fully negative) whose log is sought.
T = Tabular (conventional) form of log, having mantissa always positive.
N = Fully negative (real) form of log when T is seminegative.
When x is numerically greater than ± 1.0, $A = T$, and N is disregarded.

Grand Prix Awarded for Long-Span Concrete Bridge

TO THE EDITOR: The accompanying view of the Podolsko Bridge, longest reinforced concrete span in Central Europe, was sent to me by Dr. Václav Janák, head of the Czechoslovakian Ministry of Public Works from 1923 to 1937. Dr. Janák and Ing. Antonín Brebera were awarded the Grand Prix at the International Exposition in Liège, Belgium, in 1939 as authors of the Podolsko Bridge Project.

Dr. Janák's name was incorrectly given at the end of my article, "Contractor Meets Close Design Tolerances in Building Long-Span Concrete Arch Bridge," in the January 1949 issue of CIVIL ENGINEERING. As head of the Bridge Department for 14 years, Dr. Janák was responsible for a series of beautiful and structurally unusual concrete bridges in Czechoslovakia.

J. J. POLÍVKA, M. ASCE
Consulting Engineer
Berkeley, Calif.



PODOLSKO BRIDGE OVER VLTAVA RIVER, Czechoslovakia, has central span of 498 ft total deck width of 27 ft 11 in., and two 19-ft 9-in. lanes for vehicular traffic.

Summit Bridge Is in Delaware, Not Maryland

TO THE EDITOR: Summit Bridge, Delaware, pictured on the cover of the July issue, is incorrectly stated to be in Maryland, both in the accompanying caption and in references to its location in Colonel Frech's article describing Army Corps of Engineers work on the structure, beginning on page 17.

Summit Bridge carries Delaware Route 71 over the Chesapeake and Delaware Canal, and is about 4 miles west of U.S. Route 13 at St. George's Bridge.

HENRY L. MCMILLAN, M. ASCE
Pemberton, N.J.

SOCIETY NEWS

Mexico City Is Host to Memorable ASCE Summer Convention

THE SOCIETY'S SUMMER Convention in Mexico City is a meeting long to be remembered for its exceptional hospitality, its scenic setting, its background of an ancient civilization, and a technical program featuring the engineering developments of modern Mexico. Four national Societies of Engineers of Mexico cooperated heartily. These were the Associacion de Ingenieros y Arquitectos de Mexico, the Colegio Ingenieros Civiles de Mexico, the Centro Nacional de Ingenieros, and the Associacion Mexicana de Contratistas. The registered attendance of 578 included 200 engineers and their families from the United States, and the others were from Mexico and Latin America. Other foreign countries were also represented, including far-off Australia.

A colorful ceremony in the Mexico City Palace of Fine Arts, on Wednesday morning, July 13, officially inaugurated the meeting, the first to be held in Mexico City since 1907. In the absence of President Aleman Valdes, Ing. Adolfo Orive Alba, secretary of the Ministry of Hydraulic Resources, gave a warm address of welcome, to which ASCE President Franklin Thomas responded in both Spanish and English. Francisco Gomez-Perez, Assoc. M. ASCE, president of the Associacion de Ingenieros y Arquitectos de Mexico, acted as master of ceremonies.

The Society's required Wednesday morning business meeting considered a petition of the Hawaii Section asking to be attached to District 13 instead of to District 1, as at present. The petition was referred to a committee for further study and report.

Members of Board Decorated

After the opening meeting, the Board of Direction adjourned to the City Hall, which was profusely decorated with flowers and flags of the United States and Mexico intertwined, for a special ceremony honoring the visitors from north of the Border. Numerous state and municipal dignitaries were present, and Ing. Armando Santacruz, a distinguished Mexican scientist, addressed the group on the contributions of engineers and engineering to modern civilization. A representative of the mayor, on behalf of the city, then presented certificates and medals to engineers from the United States, the members of the Board of Direction, and others whom the city had selected to honor.

Technical Sessions Prove Popular

Following a joint luncheon of ASCE and other engineering groups, at the Hotel Del Prado on Wednesday noon, the first of the Technical Division meetings got under way. This general session, devoted to the water resources of Mexico, was well attended and provoked long discussion. In fact, so much interest was expressed in all the technical sessions that it was found almost impossible to close them on schedule. Some of the papers presented at the Wednesday afternoon general session and in five Technical Division meetings on Thursday are reviewed elsewhere in this issue.

Emphasis was on fostering sociability between the ASCE group and the host engineers and their wives at a buffet supper at the Hotel Del Prado on Wednesday evening. The program featured special Mexican music, but to give conversation a chance dancing was omitted.

Government Officials Entertain Group

President of Mexico Aleman Valdes received the engineers and the ladies of the party in two separate groups at a Thursday noon reception at "Los Pinos," the official home of the President.

A reception and dinner dance in the beautiful Hall of Candles at the Hotel Del Prado on Thursday evening was the social highlight of the convention and an experience in gracious entertaining that the visitors from the United States will not soon forget. Ing. Adolfo Orive Alba, secretary of the Ministry of Hydraulic Resources, and his charming wife were hosts to the entire ASCE group and as many

ASCE SUMMER CONVENTION is inaugurated in colorful ceremony in Mexico City Palace of Fine Arts on Wednesday morning. Photograph shows, left to right, ASCE Vice-President Robert B. Brooks; Alberto Flores; Vice-President Carlton S. Proctor; Past-President J. C. Stevens; President Franklin Thomas; Cabinet Member Adolfo Orive Alba; Past-President R. E. Dougherty; Luis Flores Orias; Vice-President Henry J. Sherman; and Francisco Gomez-Perez, who presided.

PICTURED AT RECEPTION BY PRESIDENT MIGUEL ALEMAN VALDES at president's home on July 14 are, left to right, ASCE Director W. L. Malony; Vice-President Henry J. Sherman; Vice-President Carlton S. Proctor; President Franklin Thomas; Miguel Aleman Valdes, president of Mexico; Adolfo Orive Alba, secretary of Ministry of Hydraulic Resources; A. M. Valdes, chairman of local arrangements; and Armando Santacruz, Jr., in charge of public relations. Visible in center of back row is Past-President R. E. Dougherty.

Mexican engineers and their wives as could be accommodated in the spacious hall. The evening was marked by native music, played by a *charros* (cowboy) band, and by dancing to a famous Mexico City orchestra.

What made the occasion particularly memorable, however, was an exhibition of native costumes, modeled by daughters of ASCE members in Mexico and their friends. Carefully rehearsed, the succession of colorful costume pageants, interspersed with little provincial dances, would have done credit to the professional stage. The pageants, presented state by state, ended with the chorus and entire audience lustily singing the national anthems of both countries. The women visitors were particularly impressed with the color, design, and utility of the costumes, some of them going back many centuries to a culture long antedating our own. The special thanks of the whole group were given Señor Orive Alba and his wife for their gracious hospitality and for their thoughtfulness in providing a glimpse into the older art and culture of the Mexican people usually denied the casual visitor.

Inspection Trips Conclude Meeting

Technical excursions to irrigation, power, tunnel, and other projects under construction in Mexico City and its vicinity, scheduled for Friday and Saturday, brought the Summer Convention to a close. Many ASCE visitors, however, availed themselves of the opportunity to see more of Mexico by taking post-convention excursions to some of the points of historic interest and scenic beauty to be found everywhere in the country. All returned to the United States with a new appreciation of the charm and amenities of life south of the Border and a warm new interest in our friends in Mexico and their problems, plans, and magnificent aspirations.

Secretary Notes Actions of Board of Direction at Mexico City

ONLY EIGHT OF the 26 members of the Board of Direction were absent from the meeting of the Board held in Mexico City, July 11–12, 1949. This fine attendance was achieved in spite of the fact that members of the Board received no mileage allowance for travel beyond the Mexico–United States ports of entry.

Revised Constitution Proposed

The Board approved a draft of a revised constitution proposed by the Committee on Organization, Constitution and By-laws, headed by Arthur W. Harrington, a former Vice-President of the Society. This draft is the result of two years' study by the Committee, in an attempt to obtain for the Society a Constitution containing all the fundamentals of the existing Constitution but stripped of its ambiguous and extraneous matter. The proposed new Constitution offers no radical changes in Society organization such as the establishment of regions as recently discussed. It is the old Constitution, streamlined and clarified. During the next six months, it is expected that the necessary petitions and other required procedures will be accomplished so that the new draft can be placed before the January 1950 business meeting of the Society. After clearing the January business meeting, the draft of the new Constitution will be submitted to the membership for letter ballot.

Engineering Bidding Condemned

After an extended discussion of the subject of competitive bidding for furnishing engineering services, the Board voted that:

"It is the sense of the Board of Direction of the ASCE that the Board is unalterably opposed to competitive bidding by professional engineers on a price basis for furnishing professional engineering services. The Board therefore directs the Committee on Professional Conduct to bring to the Board at the October 1949 Meeting, a proposed revision to the Code of Ethics which will effectively prohibit such competitive price bidding by professional engineers."

Reduction in 57th Street Income Reviewed

The Board expressed concern over a probable reduction of about $25,000 annually in the rental income of the Society's property on 57th Street, New York City. The existing lease of the property expires next December, and it appears probable that no new lease can be made except at a figure greatly reduced over the present rental obtained. The Board empowered the Executive Committee, in cooperation with the Committee on Securities, to effectuate a short-term lease for the property at the best figure obtainable.

Inactive List of Chinese Members in China Authorized

Due to the present hardship facing Chinese members of the Society resident

in China in meeting their dues and other Society obligations in American money, the Board authorized the establishment of an Inactive List covering such members for the duration of the present emergency in China. At present there are 46 Chinese members residing there.

Way Cleared for Additional West Coast Director

The Committee on Districts and Zones announced that the Metropolitan Section, District 1, has expressed its willingness to reduce its quota of Directors from four, as at present, to three and to recommend that an additional Director be assigned to the Districts centering on California.

New Convention Schedule Adopted for 1951

It is essential for the purpose of making a selection of convention cities and hotels for the 1951 meetings of the Society, that a 1951 schedule be adopted now. The Board approved a proposal by the Committee on Meetings that there be three "Conventions" of the Society that year. This schedule calls for the Annual Convention in New York in October, a Winter Convention in February, and a Summer Convention in June, the latter two to be held outside New York. This schedule assumes the adoption of the proposed new Constitution, probably in 1950. Should such approval be delayed, the established schedule for 1951 is to be maintained and substitute arrangements made for compliance with the existing Constitution relative to meetings of the Society.

Local Section Conference Scheduled for Fall Meeting

An allotment of $2,500 from savings in the present 1949 budget, was authorized to meet the costs of a Local Section Conference scheduled for Washington, D.C., during the October meeting of the Society. The authorization will permit attendance by delegates from 26 Local Sections, more than a third of al the Local Sections of the Society.

Interim Report on Engineering Fees Adopted

After two years of discussion and committee labor, the Board adopted a report by its Committee on Private Engineering Practice entitled "A Method of Estimating Fees for Professional Civil Engineering Services." The full report is given elsewhere in this issue.

Action Taken on Public Engineering Practice and Policy

The present and apparently growing practice of some agencies of government in the assignment of engineers on the public payroll to perform services on work in foreign countries was reviewed again by the Board. It was decided to assign to the Committee on Public Engineering Practice and Policy the task of formulating a Society policy covering the subject, for consideration by the Board at its October 1949 meeting.

SPECIAL MEDAL PRESENTED BY MEXICO CITY to members of Board of Direction and others from United States during recent Summer Convention of ASCE in Mexico City is pictured here. Presentation of these "distinguished visitor" medals was made by representative of mayor in colorful ceremony held in City Hall on opening day of Convention. Visitors also received engraved certificates.

Technical Publications Study Continued

The Board gave extended consideration to a report by the Special Committee on Technical Publications, Procedures and Costs. The present thinking of the Board, offered solely as guidance to the special committee, is that an acceptable method of distributing technical papers would be through the issuance of "Separates," but with an automatic mailing to two, three, or even four Technical Division groups as selected by each member, and with additional separates to be made available at a nominal cost on request.

ASCE Policy of Cooperation with Foreign Engineering Societies Reaffirmed

The Board reaffirmed its long-established policy of cooperation with foreign engineering Societies having standards comparable to our own. It reviewed the present situation relating to the pending appointment by United Nations and UNESCO of an international federation of engineering societies or some other world-engineering organization to serve in a consultative status to those bodies. The Board looked with favor upon the possibility of combining into an International Federation of Engineering Societies the so-called London Conference Group and the Pan-American Federation of Engineering Societies organized in July at a conference in Brazil. The London Conference Societies include the principal engineering societies of the countries of Western Europe, the three British Institutions, and the EJC Societies.

Proposed Conference of U.S. National Engineering Societies Endorsed

An invitation by the President of Engineers Joint Council requesting ASCE to be represented at an October 1949 conference of 15 principal national engineering societies was accepted by the Board. This conference will attempt to find ways and means of better cooperation among the societies in the accomplishment of their respective objectives, and develop a pattern for better unification of the engineering profession. This action is in line with the present activities of the ASCE Committee on Inter-Society Cooperation.

Appointments

The following appointments were announced:

ASCE representative on ECPD: V.T. Boughton, of New York, to succeed himself for a three-year term effective October 1949.

Additional personnel for ECPD Accrediting Team: Harry Rubey, Acting Dean of the University of Missouri, and Murray A. Wilson, Salina, Kans.

U.E.T. Survey Committee, Engineering Foundation: Gail A. Hathaway, Washington, D.C., member, Francis S. Friel, Philadelphia, alternate.

Freeman Fund Committee: Stanley M. Dore, Boston, for a term of five years effective October 1949.

J. Waldo Smith Hydraulic Fellowship Committee: Wm. H. Nalder, Denver, for a term of three years effective October 1949.

Interim Report: A Method of Estimating Fees for Professional Civil Engineering Services

Foreword

THIS REPORT ON fees for engineering services is the result of a nation-wide survey made during 1947 by the Society's Committee on Private Engineering Practice. Two-hundred and twenty-six firms in consulting civil engineering practice were invited to submit detailed information and make recommendations based on their experience. In general, members of ASCE head or are principals in these firms. One-hundred twenty-six of the consulting engineering organizations questioned forwarded usable information. The last Society report on fees was made in 1935.

The tabulations of types of work shown in this 1949 report are careful digests of the composite opinions of these consulting civil engineering firms engaged in all types of civil engineering work, and the firms were well distributed over the United States. The curves of median percentage rates were derived from the strict statistical composite of rates reported as current practice by these firms.

The Committee worked only with the statistics reported, the names of the respondent firms having been replaced by numbers at Society headquarters. A careful analysis was made of all information received. Many of the firms questioned also made analyses of their own records before submitting their questionnaire reports. The data and the report are, therefore, assumed to be authoritative and conservative.

The following information relative to fees for professional civil engineering services is founded on the principles set forth in Manual of Engineering Practice No. 5, adopted by the American Society of Civil Engineers on July 7, 1930.

It is contemplated that each engagement for engineering services will be based upon a fee contract negotiated at the outset which shall specify what services are to be included in the fee, as well as the range of percentage fees applicable to the problem at hand or other method of compensation to be used. Engineering service on a contingent basis is considered to be unsound and unethical business practice.

The report here presented is intended to indicate reasonable fees for engineering services, what payments, if any, are ordinarily made in addition to the percentage fee, and how such additional payments may be computed. This report is based on engineering practice within the continental limits of the United States.

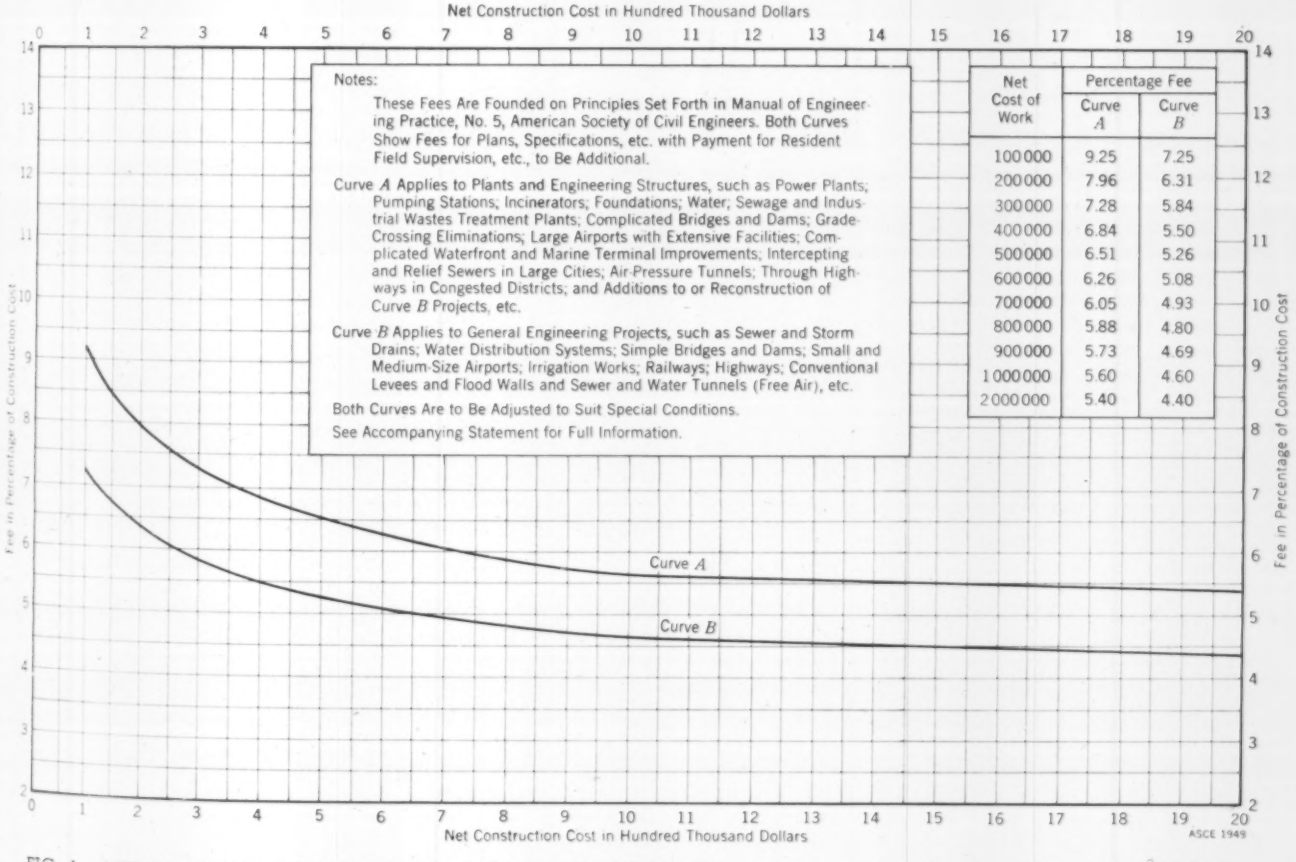
Fees for Engineering Services

Fees should be adequate to reimburse the engineer for the salary cost of his staff and overhead expense, and to afford reasonable compensation to the Engineer for his own services.

A reasonable fee for engineering services varies with:

1. The cost of the project.
2. The character and complication of the project.
3. The extent of engineering services to be furnished.
4. The experience and record of the engineering organization, related to the value of its services to the client.

The cost of some items of the Engineer's service can be estimated with a reasonable degree of certainty; the costs of other items are beyond his control and cannot be estimated closely. Two curves


Net Construction Cost in Hundred Thousand Dollars
Fee in Percentage of Construction Cost
Notes:
These Fees Are Founded on Principles Set Forth in Manual of Engineering Practice, No. 5, American Society of Civil Engineers. Both Curves Show Fees for Plans, Specifications, etc. with Payment for Resident Field Supervision, etc., to Be Additional.
Curve A Applies to Plants and Engineering Structures, such as Power Plants; Pumping Stations; Incinerators; Foundations; Water, Sewage and Industrial Wastes Treatment Plants; Complicated Bridges and Dams; Grade-Crossing Eliminations; Large Airports with Extensive Facilities; Complicated Waterfront and Marine Terminal Improvements; Intercepting and Relief Sewers in Large Cities; Air-Pressure Tunnels; Through Highways in Congested Districts; and Additions to or Reconstruction of Curve B Projects, etc.
Curve B Applies to General Engineering Projects, such as Sewer and Storm Drains; Water Distribution Systems; Simple Bridges and Dams; Small and Medium-Size Airports; Irrigation Works; Railways; Highways; Conventional Levees and Flood Walls and Sewer and Water Tunnels (Free Air), etc.
Both Curves Are to Be Adjusted to Suit Special Conditions.
See Accompanying Statement for Full Information.
Curve A
Curve B
ASCE 1949

Net Cost of Work	Percentage Fee	
	Curve A	Curve B
100 000	9.25	7.25
200 000	7.96	6.31
300 000	7.28	5.84
400 000	6.84	5.50
500 000	6.51	5.26
600 000	6.26	5.08
700 000	6.05	4.93
800 000	5.88	4.80
900 000	5.73	4.69
1 000 000	5.60	4.60
2 000 000	5.40	4.40

FIG. 1. MEDIAN FEES FOR PROFESSIONAL ENGINEERING SERVICES reported for work within the continental United States.

are presented herewith (Fig. 1) for use in estimating that portion of the engineering work for which the cost can be estimated closely and in advance. They have been developed from a study of reports of engineering fees received by consulting engineering firms located generally throughout the United States. The curves and the lists accompanying them represent a digest of the reports made by these firms.

Curves A and B apply to projects of average complexity in each group. Higher fees than those indicated by the curves are needed for unusually difficult or complicated projects. Lower fees than those indicated by the curves may be sufficient for simple projects which involve simple elements or large duplication of parts. On certain projects curves should be used incrementally, applying Curve A to portions of the project and Curve B to the balance of the project.

Curve A is intended to apply to plants and engineering structures of average complexity, but involving extensive design, research or complicated details, such as:

Power plants
Pumping stations
Incinerators
Foundations
Water, sewage and industrial wastes treatment plants
Large airports with extensive facilities
Complicated waterfront and marine terminal improvements
Intercepting and relief sewers in large cities
Air-pressure tunnels
Complicated bridges
Complicated dams
Grade-crossing eliminations
Through highways in congested districts
Additions to or reconstruction of Curve B projects

Curve B is intended to apply to general engineering projects of average complexity, such as:

Sewers and storm drains
Water-distribution systems
Simple bridges
Simple dams
Small and medium-size airports
Irrigation works
Railways
Highways
Conventional levees and flood walls
Sewer and water tunnels (free air)

Work Covered by Fee Taken from Curves

In general, the percentage fee taken from the curves (Fig. 1) should cover such of the following items as may be required:

Preliminary investigations and report
Assistance in application for public funds
Preparation of specifications for and office advice concerning test borings or other subsurface investigations
Preparation of detail plans and specifications for construction
Estimate of quantities and costs
Assistance in securing bids
Analysis of bids
Assistance in letting contracts
Checking shop and working drawings furnished by contractors
Consultation and advice during construction
Reviewing estimates for progress and final payments to contractors
Assistance in tune-up and test of equipment
Preparation of record drawings (if required by the specific engineering contract)
Final inspection and report

As the extent of work involved in making the preliminary investigations and report depends largely upon the nature and complexity of the particular project and upon the accuracy and completeness of information which the client can make available to the Engineer's use, the cost of the preliminary investigations varies widely for different projects of similar type and construction cost. The curves are understood to apply to average conditions in which preliminary investigations and report would represent from 5 to 10 percent of the engineering fee. For conditions other than average it frequently is preferable to perform the preliminary work for an appropriate, agreed lump sum fee with suitable reduction of fee for design and consultation during construction.

It is intended that the portion of the percentage fee assignable to preparation of detailed plans and specifications be based upon an agreed fair estimate of construction cost as of the date of submission of completed plans and specifications, unless construction is undertaken promptly after completion of designs in which case the total percentage fee might properly be applied to the final construction cost. The fee assignable to services during the construction period should be computed against the final construction cost, exclusive of cost for acquisition of land and rights-of-way, engineering, legal, and clients' administrative expense.

Interim payments for engineering services should be provided for as the work proceeds. Provision should be made for compensation if for any reason the work is abandoned or deferred. The details covering payments may differ with each job according to the conditions involved. It is quite customary for an interim amount to become due and payable when a preliminary study is completed and the report rendered, and again when detailed plans and specifications are completed or when the construction contracts have been signed. Sometimes such arrangements for interim payments are made on a more frequent basis. In any case, interim payments should be made promptly after the engineer has completed each phase of his work whether or not the next phase is begun.

Fee Where Scope of Work Is Difficult to Determine

There are numerous cases where the extent of engineering services required is difficult of ascertainment. Under such circumstances it is difficult to establish fees on a percentage basis, which are equitable to both Client and Engineer. Under such conditions, a reasonable fee would be one based upon all costs to the Engineer which can be definitely allocated to the project plus 200* percent of such costs, or upon some other equitable basis to be agreed upon in advance by the Engineer and the Client.

Items to Be Paid for in Addition to Percentage Fee

The following items of cost cannot be determined accurately in advance and are not within the sole control of the Engineer. Ordinarily they are paid for in addition to the percentage fee in the manner stated, and the Engineer should keep separate complete accounts of these four items:

1. Field surveys, property, boundary and right-of-way surveys, flow gaging, specialized subsurface investigations, or similar instrumental work for preliminary investigations and report; instrument surveys for design; and services of resident engineers and inspectors:
   a fee based on salary cost plus 100 percent, plus reimbursement for actual traveling and subsistence expense, long-distance telephone and telegraph charges, and similar direct field expense.

2. Services of locally employed field staff additional to resident engineer and inspectors:
   a charge based on salary cost plus 50 percent, plus reimbursement for necessarily incurred traveling and subsistence expense and supplies.

3. Furnishing reproduction of drawings or of detailed plans and specifications:
   at cost plus 50 percent service charge, or at price agreed upon with the client.

4. Services during readvertisement for bids for construction:
   a charge based on salary cost plus 50 percent, plus reimbursement for necessarily incurred traveling and subsistence expense, long-distance telephone and telegraph charges, and payment at recommended rate (par. 3) for needed

* This percentage figure supplied by the Board of Direction, ASCE.

additional copies of plans and specifications.

Limiting lump sums for the above services are often included in engineering contracts.

Special Tests. The Client should pay directly, and in addition to the percentage fee, for special tests and research, mill and shop inspection of materials and equipment, sampling and analyses of water and sewage, and for foundation explorations such as borings, test pits, and soil mechanics laboratory investigations, whether for preparation of preliminary report with estimated cost, or for final detailed plans and specifications.

Litigation. Nothing should be written in the engineering contract to obligate the Engineer to prepare for or appear in litigation in behalf of the Client, except in consideration of additional compensation.

Redesign Required by Client. When redesign of work is required by the Client after the preliminary report or preliminary plans have been approved, compensation for such redesign should be on basis of salary cost of employees plus 100 percent in addition thereto for allowance for overhead and principals' time. In addition, reimbursement should be made for traveling and subsistence expense, long-distance telephone and telegraph charges and similar direct expense occasioned by the work of redesign.

Definitions

Salary Cost includes salaries of architects, engineers, draftsmen, stenographers, clerks, etc., directly chargeable to the project. Social Security contributions, unemployment, excise and payroll taxes, employees compensation insurance, sick leave, vacation and holiday pay for such employees are considered a part of salary cost.

Overhead Cost includes general stenographic and clerical payroll with applicable taxes, insurance, sick leave, vacation and holiday allowance; office supplies; duplication expenses, including blueprinting, mimeographing, photostats, etc.; general communication expenses, including telephone, telegraph, postage, etc.; rent, light, heat, water; depreciation of furniture, equipment and books; nonproductive payroll expenditures, idle time between assignments, maintenance of staff to provide "readiness to serve"; accounting, new business solicitation, interest on borrowed working capital; local, state, and federal taxes, exclusive of income taxes; general insurance and license fees; and bonuses.

Travel and Subsistence Expense includes living and traveling expenses of all principals or employees in visiting site, attending conferences, etc.; living and traveling allowances of field supervisory and inspection staff; long-distance telephone calls and telegraph expenses directly chargeable to the project.

Submitted by the ASCE Committee on Private Engineering Practice and approved by the Board of Direction.

July 11, 1949

[Reprints of this report are available from the Executive Secretary, ASCE, 33 West 39th Street, New York 18, N.Y., at 10 cents a copy, 35 cents for 5 copies, or 5 cents a copy in lots of ten or more.]

Past-President and Honorary Member Riggs Is Dead

DR. HENRY EARLE RIGGS, Past-President and Honorary Member of the Society and former head of the Civil Engineering Department at the University of Michigan, died in a Detroit hospital on July 5, at the age of 84.

Widely known as an engineering educator, Dr. Riggs was professor of civil engineering and head of the civil engineering department at the University of Michigan from 1912 until his retirement

Past-President and Hon. M. Riggs
(1865–1949)

from active administrative work in 1930 with the title of honorary professor of civil engineering. He was a graduate of the University of Kansas, class of 1886, and in 1910 received the C. E. degree from the University of Michigan.

Dr. Riggs was also an authority on utilities, and from 1908 on his consulting work was largely in valuation and in the preparation of cases dealing with theories of valuation and depreciation. He was retained by many carriers on cases involving the federal valuation of railroads and recapture of excess profits—among them the New York Central, the Illinois Central, the Norfolk & Western, the Chesapeake & Ohio, and the Pere Marquette.

Dr. Riggs was the author of papers on valuation in the ASCE TRANSACTIONS and other publications and of a volume on depreciation, published in 1922. From 1914 to 1917 he was a member of the Society's Special Committee on Theories and Methods of Valuation, co-authoring the report of the committee, which was published in TRANSACTIONS.

A full member of the Society since 1896, Dr. Riggs served as Director from 1932 to 1934, Vice-President in 1935 and 1936, and President in 1938. He was elected to honorary membership in 1941.

Dr. Riggs' other affiliations included the Michigan Engineering Society, of which he was a former president, the Engineering Institute of Canada, the American Railway Engineering Association, the American Society for Engineering Education, the American Transit Association and the Engineering Society of Detroit.

E. B. Black, Former ASCE President, Dies

ASCE PAST-PRESIDENT Ernest B. Black, consulting engineer of Kansas City, Mo., died at his home there on July 4 after a long illness. He was 67. A graduate of the University of Kansas,

Past-President E. B. Black
(1882–1949)

class of 1906, Mr. Black had been in private practice in Kansas City since 1909 and senior partner in the firm of Black & Veatch since 1915. His firm was engaged on the construction of numerous water-supply, sewage treatment, and power projects in the West and Southwest.

During both World Wars, Mr. Black served as a consulting engineer on War

Department projects. In the first war he was also an Air Force officer assigned to the aircraft production division of the Army and chief engineer of the War Credits Board. In 1941 he went to Washington as head of the water engineering branch of the Army Quartermaster Corps, supervising the construction of water supplies at all Army camps. He also designed and constructed the Armored Division Camp, Camp Chaffee, near Fort Smith, Ark.

A corporate member of ASCE since 1910, Mr. Black served as Director from 1932 to 1934, and as President in 1942. He had been a member and chairman of the Society's Committee on Local Sections and of the executive committee of the Engineering Economics Division, and a member of the Committee on Technical Procedures, and many others. Active, also, in the affairs of the Kansas City Section, he served as president in 1928.

Mr. Black belonged to the American Institute of Consulting Engineers, the New England Water Works Association, the American Water Works Association, and the Engineers' Club of Kansas City, of which he was a former president. During a term as president of the Missouri Society of Professional Engineers, he was active in securing the state law making registration of engineers compulsory. His civic activities included long service on the executive board of the national council of Boy Scouts.

Ernest E. Howard Is Nominated for ASCE President

ERNEST E. HOWARD, of the Kansas City and New York consulting firm of Howard, Needles, Tammen & Bergendoff was nominated for 1950 President of the Society by the ASCE Board of Direction at its Summer Convention in Mexico City. A corporate member of the Society since 1905, Mr. Howard served as ASCE Director for District 16 from 1941 to 1943, and as Vice-President for Zone III in 1945 and 1946. His other services include membership on the Society's Local Membership Committee and the Committee on Fees. He has also been active in the Kansas City Section, which he has served as president.

A graduate of the University of Texas in 1900, Mr. Howard has been engaged in private engineering practice since 1901, specializing in the design of bridges and similar structures. He has been a partner in the successive firms of Harrington, Howard & Ash; Ash, Howard, Needles & Tammen; and Howard, Needles, Tammen & Bergendoff, with offices in Kansas City, Mo., and New York. Mr. Howard has been responsible for the design and construction of hundreds of important bridge projects in 36 states and several foreign countries. He also participated in an advisory capacity on the construction of the Detroit-Superior Viaduct, the Pulaski Skyway, and other notable structures. Currently, Mr. Howard has been appointed to the Commission on Renovation of the White House.

In World War I, Mr. Howard was commissioned a captain in the Corps of Engineers and served at Fort Benjamin Harrison. Following Pearl Harbor, his firm took part in the war effort. Their projects included the Southwestern Proving Ground, the Bluebonnet Ordnance Plant, additional facilities at Fort Riley, and special design work for the Engineer Board of the Army.

ERNEST E. HOWARD
Nominee for President, 1950

Mr. Howard's researches in ancient engineering construction have led to a keen interest in archaeology, and he was for several years president of the Kansas City chapter of the Archaeological Institute of America. He has been for a number of years chairman of the Board of Trustees of the University of Kansas City, of which he was one of the founders. In 1939 the University of Nebraska conferred on him the honorary degree of doctor of engineering.

His affiliations, in addition to ASCE, include membership in the American Institute of Consulting Engineers, the Engineering Institute of Canada, the American Society of Mechanical Engineers, the Missouri Society of Professional Engineers, the Engineers Club of Kansas City, Phi Beta Kappa, and Tau Beta Pi. He is also a member of the International Association for Bridge and Structural Engineering, which he represented at the third congress of the association in Liege, Belgium, in September 1948, and a charter member of the Missouri State Board of Registration for Architects and Professional Engineers.

Confirmation of Mr. Howard's nomination is scheduled by letter ballot later in the year, and he is expected to take office at the Society's Annual Meeting in New York next January. A more detailed account of his career will appear in a later issue.

American Engineers Read Papers at Rio de Janeiro

ENGINEERING IN THE service of peace was the theme of the first Pan-American Engineering Congress, held in Rio de Janeiro, Brazil, July 15 to 24. About 30 engineers from the United States—many of them ASCE members—appeared on the program, which was unusually comprehensive in scope. Subjects dealt with included the major branches of engineering, including industrial and agricultural engineering. The civil engineering field was represented with papers on various phases of transportation, communication, construction, power, city planning, and engineering teaching.

Edward P. Hamilton, M. ASCE, served as one of the Society's delegates to the congress and presented a paper on "Engineering Literature and Its Role in Pan-American Development."

The congress was sponsored by the South American Union of Engineering Associations, under the direction of Saturnino de Brito, president of the group. A preliminary meeting of the sponsoring group was held in São Paulo preceding the congress proper.

Small ASCE Lapel Pin May Still Be Ordered

A LIMITED SUPPLY of the small Society emblem suitable for lapel wear, authorized by recent action of the Board of Direction and announced in the February and March issues, is still available upon application to ASCE Headquarters. The new lapel pin is a small blue shield, ⅞ in. high, with a buttonhole fastener.

For convenience in purchasing the pin, which sells for $4, an order blank is provided on page 81 of the advertising section of this issue.

Questions About Society Group Plan of Disability Insurance Answered

MEMBERSHIP INTEREST in the Society's group plan of health and accident insurance, announced in the May and June issues, is evidenced by an immediate and overwhelming response to questionnaires mailed to all members early in July by the Continental Casualty Co., of Washington, insurance underwriters for the Society's plan. This response took the form of applications, checks, and requests for further information. Some of the questions asked most often are repeated here, with answers, for the convenience of members.

1. *Q.* Who is eligible for the group plan of accident and sickness insurance sponsored by the Society?

A. Only members of the ASCE in good standing who are under age 70 and who are gainfully employed.

2. *Q.* For what reason could the company decline to renew the policy on its annual premium anniversary date?

A. Only under any of the following conditions:

(*a*) If the insured ceases to be a member of the Society.
(*b*) If the insured is no longer gainfully employed.
(*c*) Upon reaching age 70.
(*d*) For non-payment of premium.
(*e*) If all of the policies in the Society should be terminated.

3. *Q.* If a Society member is pensioned at age 65, does the coverage continue up to age 70?

A. No, unless his pension permits him to be gainfully employed, and he is so employed, so that the insurance company may have some measure of his ability to work.

4. *Q.* What is meant by "gainfully employed?"

A. Being engaged in any business or profession, where engineering training is directly or indirectly applicable.

5. *Q.* Can the company reduce or prorate the indemnity because of other accident and health insurance held by the insured?

A. No, indemnities cannot be reduced because of other insurance held. Full disability benefits will be paid, in addition to any other coverage.

6. *Q.* When do benefits commence and how long are they paid?

A. (*a*) When disability is caused by accident, weekly indemnity starts with the first day and may continue up to five years.

(*b*) When disability is caused by sickness, weekly indemnity starts with the eighth day of sickness or the first day of hospitalization, whichever occurs first, and continues up to 52 weeks.

7. *Q.* How are disputed claims settled?

A. When necessary, disputed claims will be arbitrated by a committee named by ASCE to include a representative of the company, whose decision will be final.

8. *Q.* Is there any provision for disability payment for non-disabling injuries?

A. Yes. In the event of non-disabling injury, the company will reimburse the insured for medical and surgical expenses up to an amount equal to one week's indemnity.

9. *Q.* Are there any accidental death or dismemberment benefits?

A. Yes, principal sum and specific indemnity scheduled in the policy.

10. *Q.* In the event of a specific loss involving a percentage of principal sum, are other benefits payable?

A. Yes, the benefits under "Specific Losses" are paid in addition to all other benefits.

11. *Q.* Are airplane accidents covered?

A. Yes, except those resulting from private flying.

12. *Q.* If, in the event of disability followed by recovery and resumption of duties, the insured suffers a relapse or recurrent condition, or if another disability develops, would the insured be entitled to further benefits?

A. Yes, even if the insured suffers extended illness disability and sustains a relapse or a different illness after resuming his occupational duties, he is entitled to as much as 52 weeks benefit for each attack of illness.

13. *Q.* Is house confinement required for either sickness or accident?

A. No, full benefits are paid whether the insured is confined to the house or not.

14. *Q.* Does the policy contain any restriction as to type of illness or preexisting ailments?

A. No. It pays benefits for total disability from any illness, even though the cause might have originated before the policy's inception date.

15. *Q.* Are there any claims that can be excluded?

A. The policy contains no restrictions, except war, suicide, and private flying. The insured is covered for any accident or any sickness any place in the world.

16. *Q.* Can policy be restricted or modified by the company at any time after it is issued?

A. No, it cannot.

17. *Q.* Will the benefits decrease when the insured advances in age?

A. No.

18. *Q.* Is membership in a Local Section of ASCE required to obtain the insurance?

A. No, only membership in the ASCE is required, since all Society members are allocated to some Local Section.

19. *Q.* How does the cost of the group plan compare with an individual accident and health policy?

A. The wholesale purchasing power of the membership of the Society makes it possible to secure much broader coverage at a substantially lower cost than any member could buy as an individual.

20. *Q.* Has any other professional society made available to its members a plan similar to the group plan, which has just been announced by ASCE?

A. Yes. The engineering profession is one of the latest to make such a plan available to its members.

Hydrology Handbook Is Issued as Manual No. 28

THE ASCE *Hydrology Handbook*, which was announced in the July issue, is now being completed and will be issued as No. 28 of the Society's Manuals of Engineering Practice. In developing the manual, the special Committee on Hydrology of the Hydraulics Division was expanded to include many of the most eminent men in the various fields treated. The result is an authoritative treatment, prepared by specialists for widest use by practitioners as well as students.

Separate chapters cover (1) precipitation, (2) infiltration, (3) runoff, (4) evaporation and transpiration, and (5) groundwater storage. All are documented by extensive references. Special efforts were made to have the printing of the manual advanced so that it will be available for classroom use during the coming college year.

The 192-page book is being issued with both cloth and paper covers, with the customary concession in price to members of the Society and its Student Chapters, as follows:

Paper Covers—non-members, $3 per copy; members, $1.50 per copy.

Cloth Covers—non-members, $4 per copy; members, $2.50 per copy.

For convenience in ordering, a special form will be found on page 85 of the advertising section.

Fall Meeting to Spotlight Engineer's Role in National and International Affairs

PARTICIPATION OF engineers in developments at local, national, and international level will be discussed in detail at the ASCE Fall Meeting, to be held in Washington, D.C., November 2–4. Preceding the convention proper will be the usual meetings of the Board and Student Chapter and Local Section conferences. The attendance of delegates from 26 Sections, more than a third of the Local Sections of the Society, will make the latter conference especially important.

Subjects of concern to civil engineers in every branch of the profession have been arranged by ten of the Society's Technical Divisions. Participating Divisions will be the Air Transport, City Planning, Construction, Highways, Hydraulics, Power, Sanitary Engineering, Structural, Surveying and Mapping, and Waterways. Of special interest will be a paper on the renovation of the White House, which will be presented under the auspices of the Structural Division.

The White House will also be the objective of one of the numerous scheduled inspection trips that will include the most interesting construction projects in the capital city. Other tours are being arranged to various government laboratories and buildings, monuments, and points of historical interest in and near Washington. Among research and development laboratories to be visited are the Naval Ordnance Laboratory at White Oak, Md., and the David Taylor Model Basin at Carderock, Md.

A variety of entertainment is planned, with special attention to social functions for the ladies. Teas, tours, banquets, and balls will be featured. The September issue of CIVIL ENGINEERING will carry a full program of all events and an announcement of Technical Division speakers and their subjects.

Though Washington is served by all means of transportation and is readily accessible from all parts of the country, it will be well to make travel plans as soon as possible. Visitors are also urged to make early hotel reservations at the Hotel Statler, Fall Meeting Headquarters, in order to assure desired accommodations. The Statler has set aside a large block of rooms for members attending the meeting, and arrangements have also been made with other fine hotels in the city in anticipation of large attendance. Requests for rooms should be made to the Hotel Statler, Washington, D.C.

WHITE HOUSE REBUILDING PROJECT, which will involve complete reconstruction of this historic structure without alteration of its appearance at cost of from $6,000,000 to $10,000,000, will be objective of one of ASCE Fall Meeting inspection trips. Structural Division is also arranging for presentation of papers covering technical details of project.

NOTES FROM THE *Capital*

Joseph H. Ehlers, M. ASCE
Field Representative, ASCE

IN THE MIDYEAR Economic Report, the President stated that "The economic situation does not now call for an immediate and sweeping expansion of public works," but he added, "It would be dangerous, however, to neglect the precautionary preparation of measures which might be needed if the business downturn should become more serious." He urged that Congress:

> (1) Enact legislation to provide for loans to assist state and local advance planning of public works; (2) provide funds for the Public Buildings Administration for advance planning and site acquisition for federal construction under the authority recently enacted; (3) enable the Bureau of Public Roads to make advances to states for acquiring and clearing rights-of-way; and (4) provide for the surveys and planning for school construction which I have previously recommended. Together with the advance planning already under way by many federal agencies, these actions will round out a substantial backlog of planned public works."

Bills to implement the President's recommendation of advance planning of local public works are under study in committees of Congress. Advance planning and site acquisition of federal buildings was recently approved as Public Law 105—81st Congress, but no funds have as yet been appropriated. Engineers should be satisfied with the recommendations on advance planning, not only as a means of providing a reserve shelf of public works in the event that an accelerated public works construction program is undertaken, but as a desirable step in the orderly planning of engineering projects and a means of avoiding hastily conceived and poorly engineered public works developments.

General Services Administration Launched

Last month we reported a change in top command at the Federal Works Agency. This month we have to report the untimely demise of that Agency. A brand new federal agency, the General Services Administration, has started operations in part along lines suggested by the Hoover Commission, which recommended creation of an agency to take over federal supply, records management, and the housekeeping operations of public buildings. A rival plan to attach some of the supply and property disposal functions of the government to the Federal Works Agency had been developed in recent months, but the end result was the absorption, at least temporarily, of the Federal Works Agency by General Services Administration.

Consolidated in GSA (P.L. 152—81st Congress) are all functions of the Federal Works Agency; the Bureau of Federal Supply and the Office of Contract Settlement, from the Treasury Department; the National Archives Establishment, and the War Assets Administration. All functions of the Federal Works Administrator, of the Commissioner of Public

Buildings, and the Commissioner of Public Roads are transferred to the Administrator of General Services.

In Reorganization Plan No. 7 of 1949, dated June 20, the President indicates that the transfer of the units of the Federal Works Agency to GSA is but a temporary move. Plan No. 7 transfers the Public Roads Administration to the Department of Commerce in accordance with a recommendation of the Hoover Commission. In submitting the plan, the President stated:

"Its functions, therefore, do not fall within the field of activities of the General Services Administration. Their inclusion cannot but complicate and impede the development of the General Services Administration in the performance of its intended purpose. This reorganization plan will eliminate such a difficulty. . . . The sooner these unrelated programs can be removed from the new agency, the sooner it can concentrate its efforts on improving administrative services. . . ."

Although several of the other reorganization plans submitted have been tacitly approved by Congressional committees, no action has as yet been taken on Plan No. 7. It becomes effective on August 19, if Congress remains in session until then, unless either House votes adversely on it or possibly the President is prevailed on to alter the plan.

Considerable opposition developed to these current and prospective shifts—to transferring Public Roads to Commerce; to putting FWA units in GSA; and also to taking them out now that they are in. The situation is confusing and, in any event, the handling of these functions is left in an unsatisfactory state from the viewpoint of the engineer. The current changes do not seem to provide a final answer to the handling of public works activities in the federal government.

Professional Provisions Retained in Senate Labor Bill

The proposed "Labor Management Relations Act of 1949," as passed by the Senate, proved to be a Taft version, and for the time being has ended the attempt of the Administration to put the old Wagner Act back on the books. ASCE has been interested in one phase only of this contest, namely, to retain the provisions of the existing law guaranteeing to professional employees the right to select bargaining units of their own choice. The new Senate bill contains the professional provisions of the existing law as well as the definition of professional employees exactly as recommended by the panel which presented the viewpoint of the engineering societies to the committee. Should the House accept the new Senate bill, it would quite possibly be vetoed, leaving the Taft-Hartley Act intact. It thus appears that in either eventuality the professional provisions are safe at least until 1951.

Per Diem for Engineers Restored

In the June issue mention was made of a provision in the Bureau of Reclamation appropriation bill which would limit the payment for consulting engineers engaged on a per diem basis to about $50, in place of the $100 per day maximum now permitted. ASCE requested the Senate Appropriations Committee to eliminate the restriction and restore the $100 maximum. This appropriation bill has been reported out of Committee with the change recommended by the Society.

Federal Housing Bill Signed

The controversial "Housing Act of 1949" providing for public housing, slum clearance and housing research, recently passed by Congress after acrimonious debate, has been signed by the President.

The Senate Commerce Committee approved a bill (S. 868) providing for the dissemination of technological, scientific, and engineering information to American business and industry by the Department of Commerce. No action has been taken in the House.

White House Advisory Committee Appointed

Senator Kenneth McKellar, chairman of the Joint Congressional Commission on Reconstruction of the White House, has announced the appointment of two engineers and an architect to aid in reconstruction of the White House. They are ASCE Presidential nominee Ernest E. Howard, of the Kansas City firm of Howard, Needles, Tammen & Bergendoff; Emil H. Praeger, M. ASCE, partner in the Long Island City engineering firm of Madigan-Hyland; and William A. Delano, New York City architect. All will serve as consultants on the Commission on Renovation of the White House, to which Maj. Gen. Glen E. Edgerton, M. ASCE, Army Corps of Engineers (retired), was previously named executive director.

Washington, D.C.
July 21, 1949

TOTAL MEMBERSHIP AS OF JULY 9, 1949

Members	7,421
Associate Members	9,606
Corporate Members	17,027
Honorary Members	41
Juniors	8,974
Affiliates	72
Fellows	1
Total	26,115
(July 9, 1948)	23,762)

NEWS OF LOCAL SECTIONS

Recent Activities

AKRON

THE HISTORY OF the clay pipe industry was outlined at the Akron Section's last meeting of the season by Benjamin Eisner, chief engineer of the Clay Sewer Pipe Association. Mr. Eisner described the various methods of bedding and jointing pipe, and answered a number of questions from the floor. It was announced that the Section's next meeting, on October 6, will be devoted to surveying.

DISTRICT OF COLUMBIA

CONSTRUCTION OF THE DuPont Circle Underpass, a Washington project designed to reduce traffic congestion at a ten-point intersection, was viewed by members of the District of Columbia Section on a recent afternoon inspection trip. Later Gerard I. Sawyer, assistant engineer of bridges for the District of Columbia Department of Highways, explained the scope of the project, which includes two tunnels for street cars and one two-way automobile tunnel. Construction problems encountered were described by J. J. Hartke, resident engineer on the project for the Bridge Division of the District Department of Highways. Among these were bad soil conditions (undisclosed by the test borings), which required considerable revision of the shoring design. The program was made possible through the courtesy of John McShain, contractor on the project; Paul Hauck, manager; and Paul Brooks, superintendent.

DULUTH

A REVIEW OF the symposium on multipurpose reservoirs in the March PROCEEDINGS constituted the technical program at a recent meeting. The discussion was led by Arthur C. Josephs and Col. David A. Morris. Guests of the Section were John Butler, son of ASCE Director Gordon Butler, and Dale E. Ginn, contracting engineer of the Pittsburgh and Des Moines Steel Co.

INTERMOUNTAIN

CHARACTER IS THE essential qualification for success in the engineering profession and there is no substitute for it, ASCE President Franklin Thomas said at a recent career conference sponsored

SPEAKERS AT RECENT MEETING OF INTERMOUNTAIN SECTION—ASCE Vice-President John W. Cunningham (left) and Roy McLeese, Utah state highway engineer (right)—chat with Section President Milton T. Wilson.

by the Section and the Utah State Agriculture College Student Chapter. "The best reputation the engineering profession has is its reputation for honesty, and it is up to all engineers to maintain it," President Thomas declared. During the evening Section prizes of Junior membership in the Society were presented to David Scott and Nolan Daines, of Utah State. Two technical papers were read by Garth Tolley, member of the University of Utah Chapter, and W. L. Meikle, of the Utah State Chapter. ASCE Vice-President John Cunningham reviewed Society affairs at a dinner meeting held at the University of Utah, commenting particularly on the proposed plan for redistricting and the professional advantages of affiliating with Engineers Joint Council. The technical speaker was Roy McLeese, chief engineer of the Utah State Road Commission, who explained Utah's new long-range highway program.

FLORIDA

SEWAGE TREATMENT AND the organisms involved in the process were discussed at a recent Section meeting, held at the University of Florida in Gainesville, by Wilson T. Callaway, assistant professor of sanitary science at the university. Prof. C. D. Williams, head of the civil engineering department, addressed the student contingent present on the advantages of membership in the Student Chapter and stressed the importance to the young engineer of affiliating with a professional society. During the business meeting, the Section's activities in support of the professional engineer provisions in the pending Congressional labor legislation were reviewed.

ILLINOIS

CURRENT ACTIVITIES OF the Board of Direction were reviewed by ASCE Director Samuel Greeley at one of the Section's weekly luncheon meetings. Mr. Greeley commented particularly on the proposed plan for Society reorganization and discussed pending legislation of special interest to the profession. Other luncheon speakers were F. W. Edwards, who described investigations in filling and emptying locks and in the control of surges in a confined chamber made in the Panama Canal Laboratory, and Otto K. Jelinek, whose subject was "The Douglas Airport." Another recent program featured the presentation of certificates of Junior membership in the Society to six Student Chapter members in the Section. The winners were Kenneth F. McGann and Wendall L. Rowe, of the University of Illinois; Thomas K. Breitfuss and William H. Rittweger, of Northwestern University; and Wilbert Kautz and Donald E. Miller, of the Illinois Institute of Technology.

The work of the Federal Bureau of Investigation was described at a meeting of the Junior Group by George R. McSwain, director of the F.B.I. in the Chicago area. Mr. McSwain told the group that "The glamour connected with the F.B.I., as with engineering, is incidental compared with the plain old-fashioned hard work."

SAN DIEGO

PROGRESS BEING MADE towards integrating the engineering profession was discussed by ASCE President Franklin Thomas at a recent joint meeting of the Section and the other constituent groups of the San Diego Engineering Council. President Thomas cited, particularly, the unifying effect of Engineers Joint Council on the profession. The principal speaker at another recent meeting was Capt. C. R. Johnson, public works officer for the Eleventh Naval District, who described wartime construction conditions in Iceland and England.

TOLEDO

OPERATION OF THE Toledo sewage treatment plant and plans for its future expansion were discussed at a recent dinner meeting by Arthur Niles, plant superintendent. During the business session, action was taken to establish an annual award of Junior membership in the Society for a graduating senior at the University of Toledo.

SACRAMENTO SECTION

CONTROVERSIAL FEATURES OF the so-called Reber Plan for construction of dams in San Francisco Bay were explained at one of the Section's weekly meetings by Wayne A. Perkins, senior engineer on the design and construction of dams for the California State Division of Water Resources. Other recent luncheon speakers included ASCE Director Sidney Harding, who described problems involved in Society reorganization, and A. P. Heiner, assistant to the vice-president of the Kaiser Co., who discussed the organization's steel-making operations. A special program, conducted by the Junior Forum, consisted of a mock Section meeting, laid 30 years in the future, that gave a bright picture of the development of engineering and the place of the engineer in society.

"What Can the ASCE Do for Prospective Engineers?" members of the Junior Forum asked in a panel discussion comprising the program at their June meeting. Topics covered were college curriculums, salaries, and the obligation to keep students informed of developments in the engineering field. Junior Forum officers, elected for the last half of 1949, are Sid McFarland, president; William Gianelli, vice-president; and Irving Schultz, secretary-treasurer.

JUNIOR FORUM QUINTET OF SACRAMENTO SECTION performs at meeting devoted to giving members a glimpse into the future of their profession. Shown, left to right, are R. L. Hants, W. W. Shutte, Clayton Giroux, O. H. Degenkolb, and J. C. Nelle.

NEWS BRIEFS

Construction Total for First Half of 1949 Exceeds 1948 Record

A RECORD TOTAL of nearly $8.5 billion was spent for new construction in the first half of 1949, according to a recent U.S. Department of Commerce release. This total is about $300 million (4 percent) higher than the previous record dollar value of new construction put in place in the first six months of 1948. Though private expenditures, at $6.2 billion, were 5 percent lower than last year, public agencies spent more than $2.2 billion—an increase of 37 percent over the corresponding period in 1948.

The total value of new construction put in place in June was more than $1.7 billion, a better than seasonal increase of $175 million from the revised estimate for May and $5 million above the June 1948 total, according to the Construction Division of the Department. Both private and public expenditures increased 11 percent in June over the total for last month.

Private residential building, exclusive of farm dwellings, was valued at $600 million in June, an increase of 13 percent over the May estimate, reflecting a step-up in construction of new housing units started in April and May. The value of private home construction was 12 percent lower than last year's record totals for both June and the first half of the year.

Industrial and commercial construction activity in June continued generally below last year's levels for the month, despite a seasonal increase in the value of work done on new stores, restaurants, and garages. Other types of private nonresidential building (churches, private schools, hospitals, and recreational facilities)also showed less than seasonal advances, although the value of work put in place on these types of construction was still considerably higher than for the same period of 1948. Public utility construction work rose 11 percent in June, chiefly as a result of increased expenditures by privately owned gas and electric utilities.

Expenditures by public agencies for new construction amounted to a total of $518 million in June, 11 percent more than in May and 28 percent above the June 1948 total. The June increases in the value of work done on public projects were nominal, except for highway work, which advanced 25 percent over the May estimate.

Production of building materials in April showed a less than seasonal increase of only 0.5 percent over March, the Department of Commerce reports. The Department's monthly production index of construction materials is about 8.5 percent below April of last year.

This unexpectedly low showing is attributed largely to a drop in lumber production. Construction Division officials state that while the April output, exclusive of lumber, was only about 2 percent below that of March, lumber production accounts for almost 50 percent in arriving at the overall total of the Department's index. Four other materials that count heavily in the index total—cement, brick, and asphalt roofing and siding—showed production increases of from 5 to 34 percent in April.

Need for More Tests Emphasized at ASTM Annual Meeting

THE NEED FOR more standards and test methods suitable for the development and application of new materials is very much in evidence, Richard Templin, M. ASCE, retiring president of the American Society for Testing Materials, said in a leading address at the recent 52nd annual meeting of the ASTM in Atlantic City, N.J., which was attended by almost 2,000. Reviewing "The Progress of ASTM," Mr. Templin stressed the fact that testing activities "must be kept closely attuned to the needs of those whom they serve. These include industry, other technical societies, the government, technologists, and many others."

Mr. Templin cited several examples of further work that needs to be done. "In past years, for example," he said, "emphasis has been placed upon test methods which were intended to be a part of material or product specifications. In many instances, the methods have been defined only in sufficient detail suitable for routine inspection tests. When these tests are used for more precise investigation of the materials, the deficiencies in the test-method details often become manifest."

Stating that while, "Many tests not directly a part of product specifications are often used for the improvement of commercial products and the development of new products," Mr. Templin declared that "too few users of these tests appreciate the merits of suitably standardized test methods for such purposes."

During the 22 formal technical sessions and several informal and round-table discussions held during the five-day meeting, almost 185 papers and reports were presented. On the recommendation of ASTM technical committees, 77 new tentative specifications and methods were approved, and almost 100 previous tentatives were adopted as formal standards. Of special interest to civil engineers was the action of Committee A-1 on Steel, which revised its specifications for structural steel and reinforcing bars, and authorized its Subcommittee on Structural Steel to prepare specifications for steel piling.

Also of interest to civil engineers were a number of authoritative papers in the field of concrete and concrete aggregates. ASCE members describing the results of their research in this field included C. H. Scholer, professor of applied mechanics at Kansas State College; Inge Lyse, professor of reinforced concrete and masonry bridges at the Norway Institute of Technology; W. J. McCoy, of the Lehigh Portland Cement Co.; and J. O. Hunt, manager and research engineer for the Universal Atlas Cement Co.

J. G. Morrow, metallurgical engineer for the Steel Company of Canada, will succeed Mr. Templin as president of the organization, and F. E. Richart, M. ASCE, research professor of engineering materials at the University of Illinois, is new vice-president. Elections to the board of directors include H. F. Gonnerman and M. O. Withey, Members ASCE.

New Mid-Hudson Bridge Approved by N.Y. State

CONSTRUCTION OF a $14,000,000 high-level bridge across the Hudson River in the Kingston-Rhinecliff area has been approved "as being in the public interest" by Bertram D. Tallamy, state superintendent of public works, according to a recent announcement by Gov. Thomas E. Dewey. The structure is to be built and operated as a toll bridge by the State Bridge Authority, which operates Hudson River toll bridges at Bear Mountain, Poughkeepsie, and Catskill.

Plans for the 1,700-ft suspension bridge were submitted at the request of the Bridge Authority by D. B. Steinman, M. ASCE, New York consultant, in the fall of 1948, but final approval of the project was delayed pending the outcome of Mr. Tallamy's study. In approving the project, Mr. Tallamy urged that further studies be made before exact location of the structure is determined, so that it can be integrated into urban plans for arterial route construction.

Stating that the bridge is urgently needed to relieve traffic congestion on the other mid-Hudson bridges, Governor Dewey said that increasing traffic will probably make the construction of additional crossings imperative in the next few years.

New Toll Superhighway to Traverse New Jersey

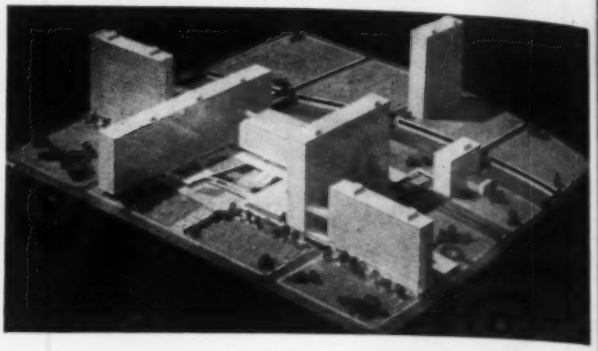
CONSTRUCTION OF THE 130-mile toll superhighway across New Jersey, recently authorized by the New Jersey State Legislature, may cost as much as $200,000,000, according to Paul L. Troast, chairman of the newly created New Jersey Turnpike Authority. Extending from Deepwater on the Delaware River in the southern part of the state to the George Washington Bridge, its northern terminus, the new highway will be one of the most heavily traveled in the country. It will also be "one of the most expensive construction projects in American history," according to Mr. Troast, because of the problems involved in taking the turnpike through the highly congested industrial area of northern New Jersey. The three-man Authority, headed by Mr. Troast, was formed by the legislature to finance, construct, maintain, and operate the new superhighway.

When the turnpike is completed sometime in 1951, it will be the most modern multi-lane highway in the world. There will be no grade intersections and no traffic lights. All intersecting roads will pass over or under the highway, and it is estimated that savings in travel time will be as much as 40 percent of the best time possible with existing highway facilities. Preliminary plans and surveys for the project are now under way, and actual construction work is scheduled to begin sometime this winter on the southern section.

Edwards & Kelcey, consulting engineers of New York City and Newark, N.J., are in charge of studies for the northern section of the highway. Other consultants engaged in route studies include O. J. Porter & Co., of Newark; Ammann & Whitney, of New York; and Frederic R. Harris, of New York and Elizabeth, N.J.

Ultra-Modern Civic Center Proposed for Chicago

HUGE CIVIC CENTER, proposed by Chicago Plan Commission, would increase efficiency and economy of federal, county, and municipal government in Chicago by consolidating offices now scattered over city. Designed as unit, center will be on site near "The Loop."



United Nations to Sponsor Conservation Conference

WATER, MINERAL, fuel, forest, and land resources will be studied on a world scale at a three-week Conference on the Conservation and Utilization of Resources, to be held at Lake Success, N.Y., August 17 to September 6, under the auspices of the United Nations. Engineers, scientists, economists, and experts in related fields from many countries have been asked to present papers at the conference.

Stating that "the primary concern of the conference will be with the practical application of science to resource management and human use," the agenda stresses the economic benefits of improved resource techniques and the importance of their widespread application as well as the need for continuous development of the techniques themselves.

Inquiries should be addressed to the Secretariat, United Nations Scientific Conference on the Conservation and Utilization of Resources, Lake Success, N.Y.

Varied Program Given at AWWA Chicago Conference

WIDE COVERAGE WAS given both engineering and administrative aspects of water works at the five-day annual conference of the American Water Works Association, which was held in Chicago recently. Local water-purification problems were discussed in the lead-off session by two ASCE members—John R. Baylis, physical chemist for the Chicago Bureau of Public Works, who described the operation of the new Chicago filters, and Leo Besozzi, consulting engineer of Hammond, Ind., who reviewed a five-month experiment in taste and odor control of Lake Michigan water. ASCE Past-President Malcolm Pirnie, New York consultant, and S. B. Morris, M. ASCE, general manager and chief engineer of the Los Angeles Department of Water and Power, headed a panel discussion on "Ethics of the Water Works Industry."

The organization recommended that water-works management aid in the addition of fluorides to drinking water, to reduce dental decay, in programs approved by the proper medical and health authorities, and heard reports minimizing the danger of contracting infantile paralysis from polluted water supplies.

A. P. Black, professor of chemistry at the University of Florida, will succeed Linn H. Enslow, M. ASCE, as AWWA president during the coming year. W. Victor Weir, M. ASCE, general manager of the St. Louis County Water Co., was elected vice-president, and William W. Brush, M. ASCE, editor of *Water Works Engineering*, was re-elected treasurer.

Numerous Society members received the George Warren Fuller Awards for 1949 in recognition of their services in the water works field. These included Louis J. Alexander, Arthur N. Beck, Harry R. Hall, Harold E. Babbitt, Lewis S. Finch, A. F. Porzelius, L. N. Thompson, Melvin P. Hatcher, Edward S. Chase, S. P. Carman, Daniel M. Williams, Frederick H. Waring, William C. Morse, and W. H. Shewbridge. The John M. Diven Medal "for outstanding service to the association," went to Harry A. Faber, of New York City, and the John M. Goodell Prize to Laurie M. Leedom.

There was an attendance of about 3,000 at the meeting.

Dragline Is Moved by Portable Power

DRAWING POWER FROM TWO DIESEL-ELECTRIC SETS, mounted on 23-ft trailer, 115-ton Bucyrus-Monighan electric walking-type dragline with 3½-cu yd bucket and 80-ft boom moves 5 miles from one Colorado coal mine to begin work on another. This method of moving huge rig, which took three days, was found to save time and expense of dismantling, transporting, and reassembling, which would have required twelve men working three weeks to accomplish.

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IOWA . . . *soil-cement* . . . a P&H Stabilizer completed a 10-mile, 24-foot road in only 20 days.

CALIFORNIA . . . *bituminous* . . . a P&H Stabilizer reprocessed a 10-year old "oil-mat" to a 3-inch depth at a rate of 1000 sq. yds. per hour.

NEBRASKA . . . *clay-gravel* . . . the sub-base of this airport was processed at 1900 sq. yds. per hour with a P&H Stabilizer.

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Virginia Highway Department Lays Rubber Road

FIRST TEST STRETCH OF RUBBER ROAD IN UNITED STATES is laid on Route 250 just outside of Richmond on Richmond-Charlottesville highway. Test section 1,000 ft long, with ½-in. surface top dressing containing rubber, was put down in three 10-ft lanes, along with 1,000-ft control section without rubber. About one-half ton of rubber per mile is required, adding $400 to construction cost of each mile of highway. Test sections installed in Europe are reported to have stood up well after more than decade of hard wear in peace and war (June issue, page 74). Supervising operations for Virginia Highway Department were J. J. Forrer, chief maintenance engineer; Shreve Clark, chief testing engineer; and T. E. Shelburne, M. ASCE, director of research for Council of Highway Investigation and Research.

Record Value of New Construction in 1949 Foreseen

DOLLAR VALUE OF new construction for the year may reach a record total of $19 billion, 1 percent above the revised figure of $18.77 billion for 1948, according to a recent release from the Construction Division of the U.S. Department of Commerce. In addition, officials of the Division predict that if construction costs continue to decline, the physical volume of construction in 1949 may show a somewhat larger percentage increase over 1948 than the dollar value.

This estimated increase, based on a mid-year review of new construction activity, is attributed largely to more construction activity by privately owned utility companies than was anticipated and to a greater than expected increase in the total amount of public construction. The value of new construction put in place in 1948 by privately owned public utilities, particularly gas and electric companies, was revised upward by a substantial amount when final figures became available. Indications are that still further increases in construction by gas and electric utilities will raise the total value of new construction by all types of utilities to more than $3.5 billion—8 percent above the revised total for last year.

Estimates now place the value of public construction for 1949 at about $5.17 billion, or 23 percent above the 1948 total. Greatly increased rates of hospital and school building will account for a large share of the expected increase. State and local housing projects, federal conservation and development work, and extension of sewer and water facilities will also contribute substantial amounts. The total value of highway work in 1949 probably will be moderately above 1948 levels.

It is expected that the total value of new private construction will reach $13.82 billion, about 5 percent less than last year. Construction of new homes exclusive of farm dwellings, which will amount to about $6.5 billion, is expected to account for nearly half the total. However, it will be 10 percent below last year's revised figure.

The continued decline in industrial construction is expected to result in a drop of about 28 percent for the year, while the value of work done on new stores, restaurants, and garages will be about 11 percent below the 1948 total. The outlook for warehouse, office, and loft building is about the same as last year. However, other types of nonresidential building are expected to show a 28 percent increase, principally as a result of 30 to 50 percent advances in work on new churches, recreational facilities, hospitals, and institutional buildings.

Highway Officials Urged to Increase Public Service

HIGHWAY ENGINEERS MUST give increasing attention to the needs and desires of the public, W. C. Lefebvre, Assoc. M. ASCE, Arizona state highway engineer, told engineers from twelve Western states attending the 28th annual conference of the Western Association of State Highway Officials, held recently in Denver. Mr. Lefebvre, retiring president of the organization, stressed the "human aspects" of engineering in a keynote address, stating that highway engineers are peculiarly dependent on public support for the success of their construction and operation programs. "We will stand or fall by our contacts with the public," he declared.

Problems involved in the secondary road construction and maintenance program were discussed in other leading talks. Carl W. Brown, M. ASCE, chief engineer of the Missouri State Highway Department, and president of the American Association of State Highway Officials, showed the importance of the secondary road program by pointing out that out of a 3,000,000-mile network of highways in the United States, only 750,000 miles are primary roads.

Both Mr. Brown and L. I. Hewes, M. ASCE, director of the Western Regional Office of the Public Roads Administration, deplored the lack of adequate funds for the secondary road program, and advised engineers to guard revenues from motor-fuel and vehicle taxes to keep them from being diverted to non-highway uses.

Other members of the Society addressing the four-day meeting included Archie N. Carter, manager of the Highway Contractors' Division of the Associated General Contractors of America; DeWitt C. Greer, Texas state highway engineer; and R. S. Corlew, maintenance engineer for Division 9 of the Public Roads Administration. The two latter headed panel discussions on problems of highway administration and maintenance.

New officers elected during the business meeting are W. T. Holcomb, president; D. C. Greer, M. ASCE, vice-president; and A. M. Nash, secretary-treasurer. Burton G. Dwyre, M. ASCE, New Mexico state highway engineer, headed the executive committee in charge of arrangements.

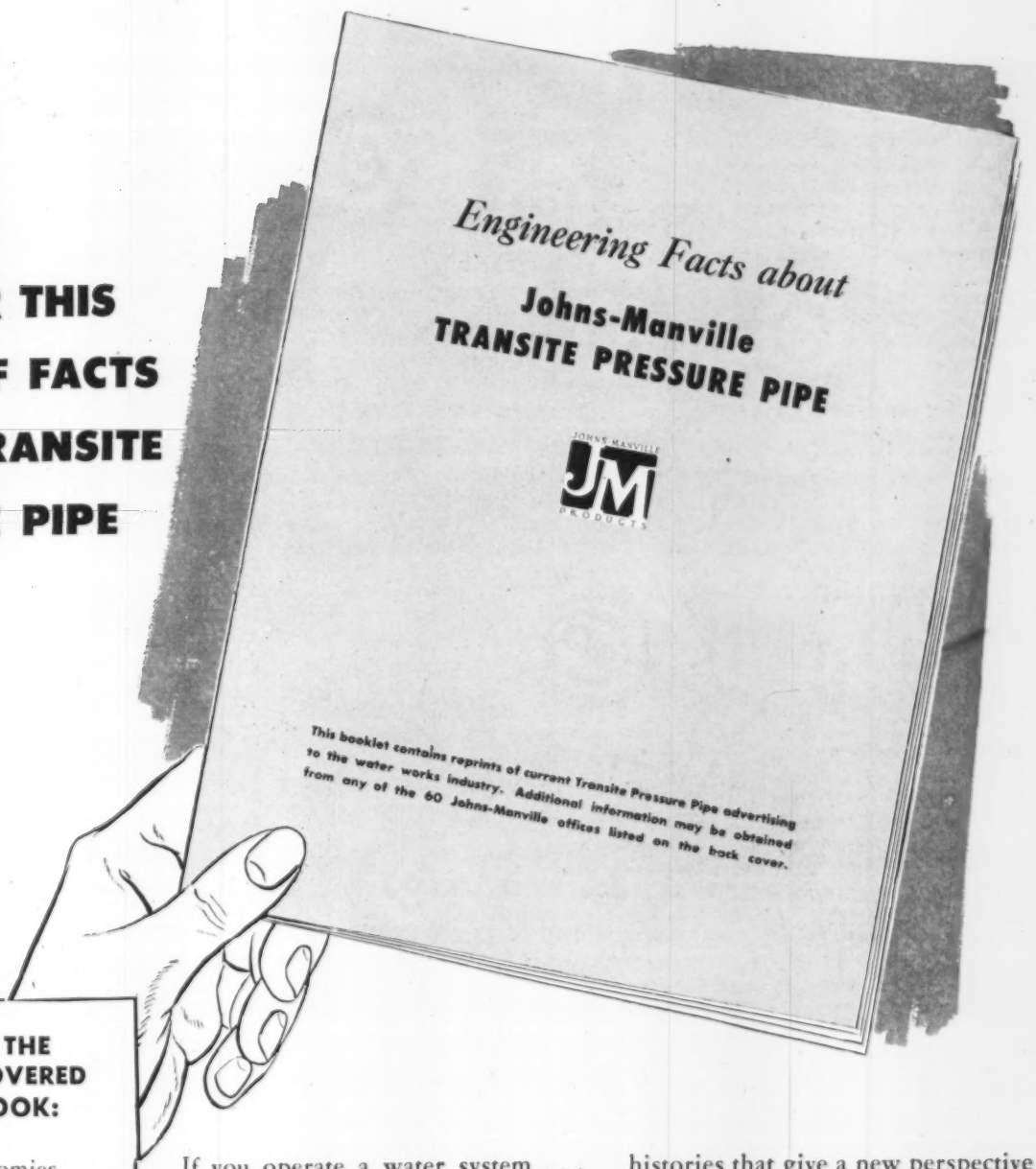
New Service Makes Available Qualified Construction Men

TO HELP AMERICAN contractors, especially those engaged on overseas jobs, avoid the delays and money losses frequently incurred through employment of incompetent construction men, the Construction Men's Association has established a new service of examination and certification of qualified employees. This service, consisting of an Examining Board to pass upon the degree of skill claimed by applicants, will permit the Association to refer to contractors only members who have passed a rigid examination and who are certified as to trade, skill, and classification.

Because of the demand for men the new overseas construction program is expected to produce, the Association has undertaken an additional function. If a contractor wishes to employ a person who is not a member of the Association, he may refer him to the Association for screening, examination, and certification. Since the organization operates on a non-profit basis, an examination fee of $10 will be charged for the service.

The Association, which has a membership of thousands of trained construction men in all parts of the world, acts as a clearing house for information on all foreign work planned or in process. Inquiries should be addressed to either of its main offices at 82 Beaver Street, New York City, or 580 Washington Street, San Francisco, Calif.

SEND FOR THIS DIGEST OF FACTS ABOUT TRANSITE PRESSURE PIPE


Engineering Facts about
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TRANSITE PRESSURE PIPE
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PRODUCTS
This booklet contains reprints of current Transite Pressure Pipe advertising to the water works industry. Additional information may be obtained from any of the 60 Johns-Manville offices listed on the back cover.

SOME OF THE SUBJECTS COVERED IN THIS BOOK:

- Installation Economies
- Carrying Capacity
- The Simplex Coupling
- Making Service Connections
- Resistance to Corrosion —an Index of Long Life
- Case Histories
- Dimensions and other useful data

If you operate a water system . . . or are concerned with the design or construction of water works projects you'll find this digest of facts about Johns-Manville Transite* Pressure Pipe helpful.

A compilation of the advertisements in our current "Engineering Facts" series, it presents concise, factual information about Transite's many economic and engineering advantages . . . includes informative case histories that give a new perspective on how this asbestos-cement pipe meets today's requirements for a modern, efficient water carrier.

In addition, it contains dimensions and other useful data about Transite Pressure Pipe which you'll want to have in your files. A copy is yours for the asking. Write Johns-Manville, Box 290, New York 16, N. Y. or use the coupon below.

*Transite is a registered Johns-Manville trade mark

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JM PRODUCTS

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Send me a copy of "Engineering Facts about Johns-Manville Transite Pressure Pipe" (TR-78A).

Name_____

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CE 8

Western Engineers Society Opens New Headquarters

THE WESTERN SOCIETY of Engineers recently celebrated its 80th anniversary by dedicating its new headquarters in the John Crerar Library property at 84 East Randolph Street, Chicago. More than 1,000 engineers and businessmen interested in the development of an engineering and science center for Chicago took part in the program, which included inspection of the three floors being taken over by the Western Society of Engineers. About $100,000 has been spent in renovating and equipping the center, which includes meeting rooms, offices, lounges, dining facilities, and an auditorium equipped with public address and picture projection systems.

V. O. McClurg, M. ASCE, is president of the Western Society of Engineers, which has a membership of about 2,500.

Sharp Decline in Steel Production in June Noted

STEEL PRODUCTION, DECLINING in June for the third consecutive month, fell to the lowest point in more than a year, according to an announcement from the American Iron and Steel Institute. The output of 6,501,332 tons for the month represented a drop of more than a million tons from the production of raw steel in May, and a decline of nearly 1,900,000 tons from the record production in March. Steelmaking furnaces during the month were operated at an average of 82.2 percent of capacity, the lowest monthly rate since April 1948.

Despite the drop in production in June, the record output in the early part of the year brought the total output of raw steel in the first six months of 1949 to 45,928,476 tons—an increase of 2,800,000 tons over production for the first half of 1948 and a first-half-year record. Steelmaking furnaces were operated at an average of 96.3 percent of capacity in the first six months of 1949, in comparison with an operation rate of 92.0 percent of capacity in the corresponding period of 1948.

Research Undertaken to Save Naval Air Station

EMERGENCY RESEARCH AIMED at saving the huge Whiting Naval Air Station, near Pensacola, Fla., from being washed out to sea is being conducted in the St. Anthony Falls Hydraulic Laboratory at the University of Minnesota. Heavy rains have eroded so many deep mile-long gullies around the plateau on which the field is located that the Navy was forced to consider abandoning the installation.

Success has already been reported in handling the problem of storm-water disposal involved in the project by development of methods for joining together two streams of water flowing at supercritical speeds. Other problems under investigation include determining the reason for failure of dams built in the drainage ditches at Whiting Field. So urgent was the need for a solution to this problem that the first experimental structure tested in the laboratory was built before a report on the model studies could be prepared. Also under study is the design for a drainage ditch outlet that will prevent the undermining and washing out of the discharge end of the ditches. Efforts to solve this problem involve experimenting with methods of diverting the water upward into a spray to dispel its force. A hydraulic drop structure of high efficiency, designed in the university laboratory, has already been put into service on the Whiting Field erosion project.

Engineers of the Soil Conservation Service are directing the research, under the supervision of F. W. Blaisdell, Assoc. M. ASCE, project engineer for the SCS at the St. Anthony Falls Laboratory. Research assistants on the project include C. A. Donnelly, of the SCS staff, and Charles E. Bowers, Jun. ASCE, of the laboratory staff. Dr. Lorenz G. Straub, M. ASCE, is director of the St. Anthony Falls Laboratory.

Ultra-Modern Plant to Be Built for Lincoln Co.

IMMEDIATE CONSTRUCTION OF an $8,500,000 manufacturing plant at Euclid, Ohio, has been authorized by the Lincoln Electric Co., to replace its present Cleveland plant, according to an announcement from James F. Lincoln, president of the company. Latest developments in design and construction will be incorporated in the new plant, which will have a capacity of over 850,000 sq ft. The steel framework for the building will be welded, and the exterior siding of aluminum without windows. Controlled heating, ventilating, and lighting facilities will maintain efficient working conditions at all times. Plant and handling equipment will be integrated to reduce materials-handling costs to a minimum.

The Austin Co., of Cleveland, is in charge of building the plant, which is scheduled for completion in 1950.

Long-Term Advance in Our Way of Life Foreseen

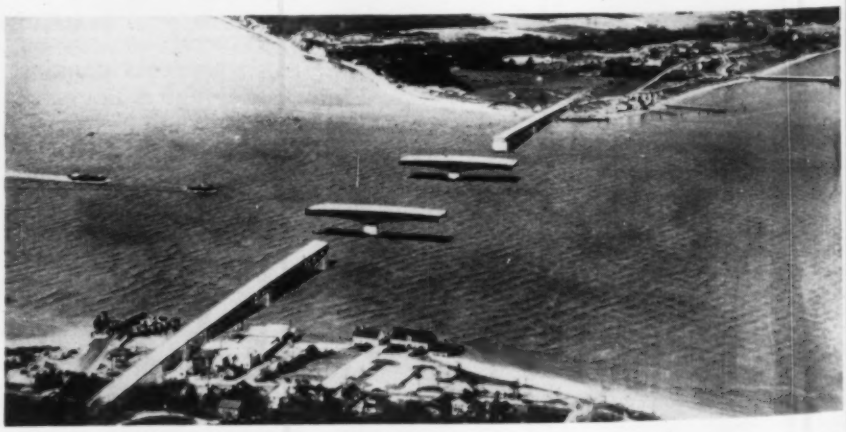
BY STEPPING UP our output only 8 percent above normal expectations, "we could produce enough by 1960 to provide adequate standards of food, housing, education, and medical care for every living American," according to a recent report of the Twentieth Century Fund that summarizes achievement in each sector of our economic life. The report, which was issued under the title, *U.S.A.: Measure of a Nation*, scorns any implication that our economic system is "running down" or "mature," and says "we face the future with the greatest assets ever possessed by any nation in history, with enormous future opportunities for both public and private investment and business growth."

Bids Sought on 3,750-Ft Highway Bridge in Virginia

THE VIRGINIA HIGHWAY Department will open bids September 1 on a 3,750-ft double-leaf swing-span bridge over the York River at Yorktown, Va. Linking the Virginia Peninsula with the upper Tidewater country of the state, the structure will be the largest ever built by the Highway Department in both quantities involved and costs. Construction will require about two and a half years.

Plans for the structure call for a clear 26-ft roadway, with two safety walks for pedestrians. At its highest point, the bridge floor will be some 120 ft above water, and when both swing spans are open the horizontal clearance will be 450 ft. Massive center piers, 40 by 60 ft in thickness, will house machinery for opening and closing the heavy swing spans, which will be the largest of their type ever built. The Department of the Interior, the War Department, and the State of Virginia agreed on the low-level double-leaf swing span as meeting modern coastal defense needs and retaining the historic atmosphere of Yorktown.

Engineers on the project are Parsons, Brinckerhoff, Hall and Macdonald, of New York City.

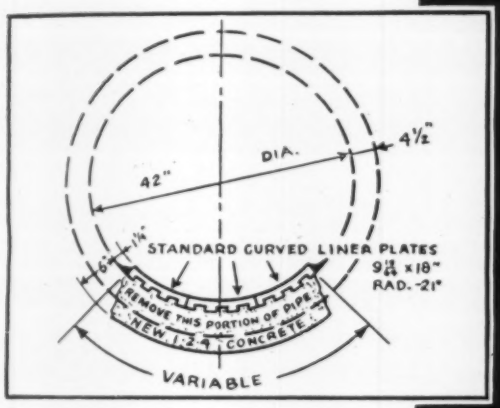


ARTIST'S CONCEPTION OF LARGE YORK RIVER BRIDGE at Yorktown, Va., on which bids will be opened September 1. Aerial photo by LeRoy Anderson, Richmond, Va. Drawing by T. E. Burton, of Virginia Highway Department.

Clay Liner Plates

SALVAGE RELIEF SEWER SYSTEM

THE Engineering Department of Cudahy, Wisconsin, recently devised an unusual method of salvaging a non-vitreous relief sewer which had disintegrated from constant attack by sulphuric acid discharged from a nearby drop forge plant. Vitrified Clay Liner Plates were used to replace the invert of the sewer to take care of the high-acid waste material flowing through the line. The sewer arch, which had not been in contact with the waste material, was saved.



Clay Pipe Passes A. S. T. M. Acid Test With Plenty To Spare

Forty-eight hours suspended in fiery solutions of sulphuric, nitric, hydrochloric, or acetic acids . . . that's the rugged A. S. T. M. test for acid resistance! And Vitrified Clay Liner Plates come through without so much as a pockmark! That's the reason Clay is specified by leading engineers the world over for sewerage and waste disposal systems of all kinds. Clay Pipe and Clay Liner Plates are made from nature's own chemically inert material . . . it *never wears out!*

C-849-2

WRITE FOR INFORMATION ON *YOUR* CLAY PIPE QUESTION

NATIONAL CLAY PIPE MANUFACTURERS, INC.

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522 First National Bank Bldg., Atlanta 3, Ga.
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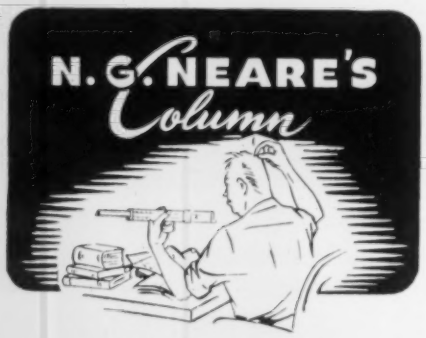
Vitrified CLAY PIPE

CLAY PIPE NEVER WEARS OUT!

Mobile Laboratory Aids in Pollution Control

FIELD COLLECTION OF DATA AND EVIDENCE to aid in stream-pollution control is provided by Ohio's new mobile laboratory, latest facility acquired by State Department of Health in its campaign for clean streams. F. H. Waring, M. ASCE (left), state sanitary engineer, outlines trouble spots that will be investigated to Department of Health confreres.



R. Robinson Rowe, M. ASCE

"SOME DAY," BEGAN the Professor, "we should have a rainbow-chasing problem, but our sunset chase will have to do until we know a little more about iridal kinetics. Right now we are interested in the velocity of the sunset line, in order to find how fast a plane is required for a round trip from equator to pole by daylight. Your show, Joe."

"Easy," replied Joe Kerr. "We learned last time that the velocity of sunset was 900 knots times the cosine of the latitude, or 300 knots when $\phi = 70.53°$. Starting at dawn 6 hr ahead of the sun and flying a quadrant through 90° of longitude to that latitude at dusk 6 hr behind the sun, the plane runs 18 hr at 300 knots. This being the sunset velocity, the pilot can finagle his way to the pole and return by a symmetrical route."

"Hard," countered Cal Klater. "Joe figured on making the trip at the equinox, but it can be made quicker at the solstice. The sunset line is then a great circle tangent to the Arctic Circle and moving so as to envelop it. If the sun's declination is δ, the normal velocity of sunset in terms of latitude is:

$$V_s = \sqrt{\cos^2 \phi - \sin^2 \delta} \quad . \quad . \quad . \quad (1)$$

Also we have more flying time because the sun's declination increases its hour angle at dusk. Instead of 6 hr, it is:

$$t_s = 6 + \frac{1}{15} \sin^{-1} (\tan \phi \tan \delta) \quad . \quad (2)$$

With these, we can set up equations for the solution of a spherical triangle OPN, where N is the pole, O the starting point on the equator, and P the point where sunset catches the plane but cannot pass because with increasing latitude the speed of sunset is just reduced to the speed of the plane.

"To make a long story short, the equations can be reduced to:

$$\cos^{-1} \frac{a}{\sqrt{1 - u^2}} = u \left(\pi + \cos^{-1} \frac{au}{\sqrt{1 - u^2 - a^2}} \right) \quad (3)$$

in which $u = \frac{V}{900}$ and $a = \sin \delta = 0.3978833$. By cut and try I found $u = 0.2494469$ and $V = 224.5022$ knots."

"Which is an easy cruising speed," agreed the Professor. "The plane starts on a course of N 14°26′41″ W, of which the sine is u, and runs 17.5697 hr to the critical sunset position at Lat 61°59′27″ N, Long 32°05′06″ W. How long did the round trip take, Cal?"

"Just 60 hr, Noah. From symmetry, the trip ends at sunset, and since it can't quite be done in 36 hr, the pilot will have to buzz the pole awhile before starting back."

"Our next problem brings us back to earth again, with former Guest Professor Jenney relating another episode in the troubled life of the surveyor, Al E. Dayde. Tell us about him, Dick."

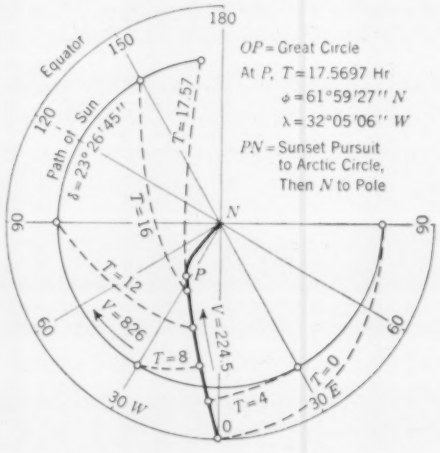


FIG. 1. FIRST LEG of daylight round trip from equator to pole.

"Al's pretty low, Noah. He took a job to measure the area of the yard around a house and had just finished when a gust of wind tore his loose-leaf notebook apart and he lost all but one sheet of his notes. On the front was a sketch showing a square house on a quadrilateral lot with its frontage 2.5 times the length of the rear line. On the back he had recorded that one house corner was 120 ft from each lot corner and that the opposite house corner was 70 ft from each lot line. What was the area of the yard?"

[*Cal Klaters were Stoop (John L.) Nagle, Anne Othernut (J. Charles Rathbun), and E. P. Goodrich. Many Joe Kerrs used graphical methods, but all encountered projectional fallacies.*]

NEW IN Education

Eastern Colleges Install Chi Epsilon Fraternities

CHI EPSILON, AN honorary civil engineering fraternity, installed chapters in several Eastern colleges during the closing days of the current commencement season. Established at the University of Illinois in 1922, Chi Epsilon now has 31 chapters and a national membership of more than 5,600. Only juniors and seniors with exceptional scholarship records are eligible for enrollment.

Engineering schools reporting the installation of chapters are City College of New York, the University of Connecticut, Cooper Union, Manhattan College, and Polytechnic Institute of Brooklyn.

The committee presiding at the installation ceremonies consisted of Douglas M. Stewart, a member of the Chi Epsilon Supreme Council and president of the Universal Bottle Gas Corp.; Harold T. Larsen, a charter member and editor of ASCE Technical Publications; Richard I. Land, of the Vermilya-Brown Construction Co.; Chilton A. Wright, professor of civil engineering at Polytechnic Institute of Brooklyn; Robert L. Stein, sales engineer for P. J. Porter & Co.; Richard Meloy, vice-president of the Penn State Chapter of Chi Epsilon; Clarence Velz, professor of sanitary engineering and head of the civil engineering department at Manhattan College; Robert Kruse, of Purdy & Henderson Associates; and Leslie W. Engler, dean of administration at City College of New York. A number of other Chapter members also assisted in the installation and initiation ceremonies, the committee personnel varying with the college.

A NEW CENTER for nuclear research has been established at Saxonburg, Pa., by the College of Engineering and Science of the Carnegie Institute of Technology.

ABOUT CAST IRON PIPE!

In 1849—one hundred years ago—Utica laid her first 6-inch cast iron pipe. Of all the 6-inch cast iron pipe laid from that date, 98.2% is still in service.

In the same year, Utica installed her first 12-inch cast iron pipe and 99% of all the 12-inch cast iron pipe laid from that date is still in service.

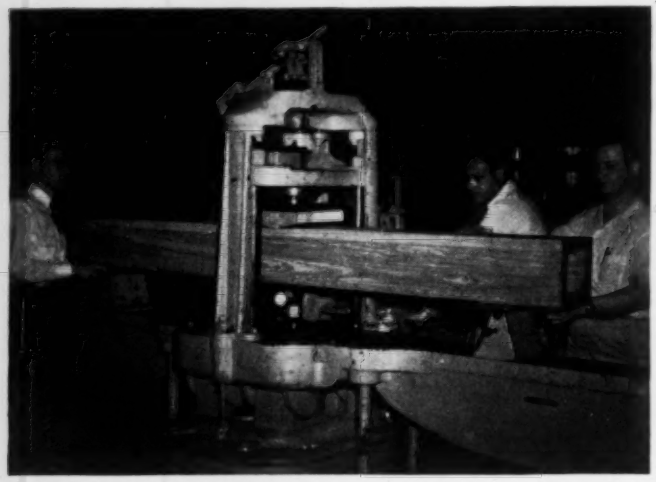
Utica is one of the cities included in the survey of "Survival and Retirement Experience with Water Works Facilities", including cast iron water mains, conducted under the auspices of the American Water Works Association, the New England Water Works Association and the Institute of Water Supply Utilities. The recently published report of the findings of the survey shows that 96% of all 6-inch and larger cast iron water mains ever laid since 1817 in 25 representative cities are still in service.

Utica's experience with cast iron water mains, therefore, while remarkable, and eminently satisfactory to her taxpayers, is not exceptional.

We shall be glad to send on request a copy of our brochure "Survival and Retirement Experience with Cast Iron Water Mains", reprinted by permission. Address Thomas F. Wolfe, Engineer, Cast Iron Pipe Research Association, 122 South Michigan Avenue, Chicago 3, Illinois.

SERVES FOR CENTURIES

V.P.I. Conducts Wood-Box Column Research Project



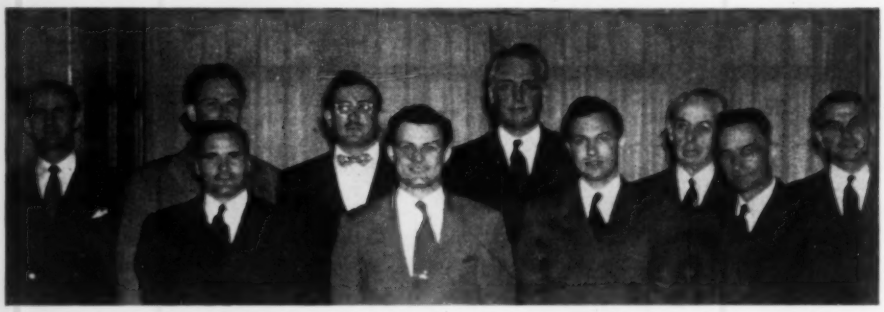
RESEARCH ON WOOD-BOX column design, for which Virginia Polytechnic Institute received grant from Research Corp., of New York, is under way in V.P.I. Wood Research Laboratory. Photo shows Southern yellow pine test column during preliminary flexure testing. At left is Prof. B. Y. Kinsey, and at right graduate student O. J. Blake, assisting Dr. E. George Stern, Assoc. M. ASCE at testing machine.

THE ASSOCIATION OF Engineering Colleges of New York State has elected the following officers for the 1949–1950 school year: Harold W. Bibber, chairman of the Division of Engineering at Union College, president; William Allan, M. ASCE, dean of the City College of New York School of Engineering, vice-president; and Brother Amandus Leo, dean of the Manhattan College of Engineering, secretary-treasurer.

CONSTRUCTION OF a million-dollar Metal Processing Laboratory building at the Massachusetts Institute of Technology has been made possible by a gift from Alfred P. Sloan, Jr., chairman of the board of the General Motors Corp., according to an announcement from Dr. James R. Killian Jr., president of MIT. "The new laboratory," Dr. Killian stated, "will enrich and extend the Institute's entire engineering program. It represents a pioneer effort on the part of the Institute to combine in an educational and research program the metallurgical and mechanical engineering approach to the fabrication of metals."

ESTABLISHMENT OF A research and development division at Villanova College, Villanova, Pa., has been announced. For the time being the new division will confine its activities to basic and applied research and development in engineering fields only. An advisory council, headed by Martin J. Gillan, professor of civil engineering, will control the new unit. Others on the board are Dr. Robert E. White, head of the chemical engineering school; John J. Gallen, Assoc. M. ASCE, and Miles Potter, professors of civil engineering; and George H. Auth, professor of mechanical engineering.

TWO NEW COURSES in mathematics for spare-time study by correspondence have been announced by the Extension Division of the University of Wisconsin. Practical Calculus, which treats elementary principles and their applications to engineering problems, will be found useful by men with limited mathematical training who need calculus in their work. The other course covers the Mathematics of Elementary Statistics.



CIVIL ENGINEERING FACULTY OF WASHINGTON UNIVERSITY (ST. LOUIS) consists entirely of ASCE members and registered professional engineers, as result of postwar policy of building up staff of high professional caliber. Since end of war staff has been increased from three to ten men, averaging 10.5 years in teaching and 7.0 years of engineering experience outside of teaching. Average age is 39. In front row, left to right, are: D. N. Cortright, assistant professor; W. A. Andrews, instructor; C. E. Lewald, assistant professor; and A. W. Brust, associate professor. In back row are: A. W. Brune, instructor; R. E. Flint, assistant professor; M. M. Lemcoe, instructor; J. W. Hubler, head of civil engineering department; E. O. Sweetser, William Palm, professor; and A. A. Brielmaier, professor.

NEWS OF Engineers

Donald D. King is now editor of *Construction Equipment and Materials*. Mr. King has had wide experience in the editorial field, successively as art editor of CIVIL ENGINEERING, editor of *Aviation Engineer Notes*, assistant editor of *Construction Methods*, and editor of CIVIL ENGINEERING. At one time he conducted his own advertising agency in New York City.

I. Ellis Behrman, director of Beth Israel Hospital, received an honorary degree of doctor of engineering at the recent 33rd commencement exercises of the Newark College of Engineering.

Theodore Belzner, with the New York City Department of Public Works as inspector of steel and bridge inspector in charge of Brooklyn Bridge, was recently presented with a Service Scroll in recognition of his lengthy service to the city at a meeting of the Department of Public Works Employees' Welfare Association.

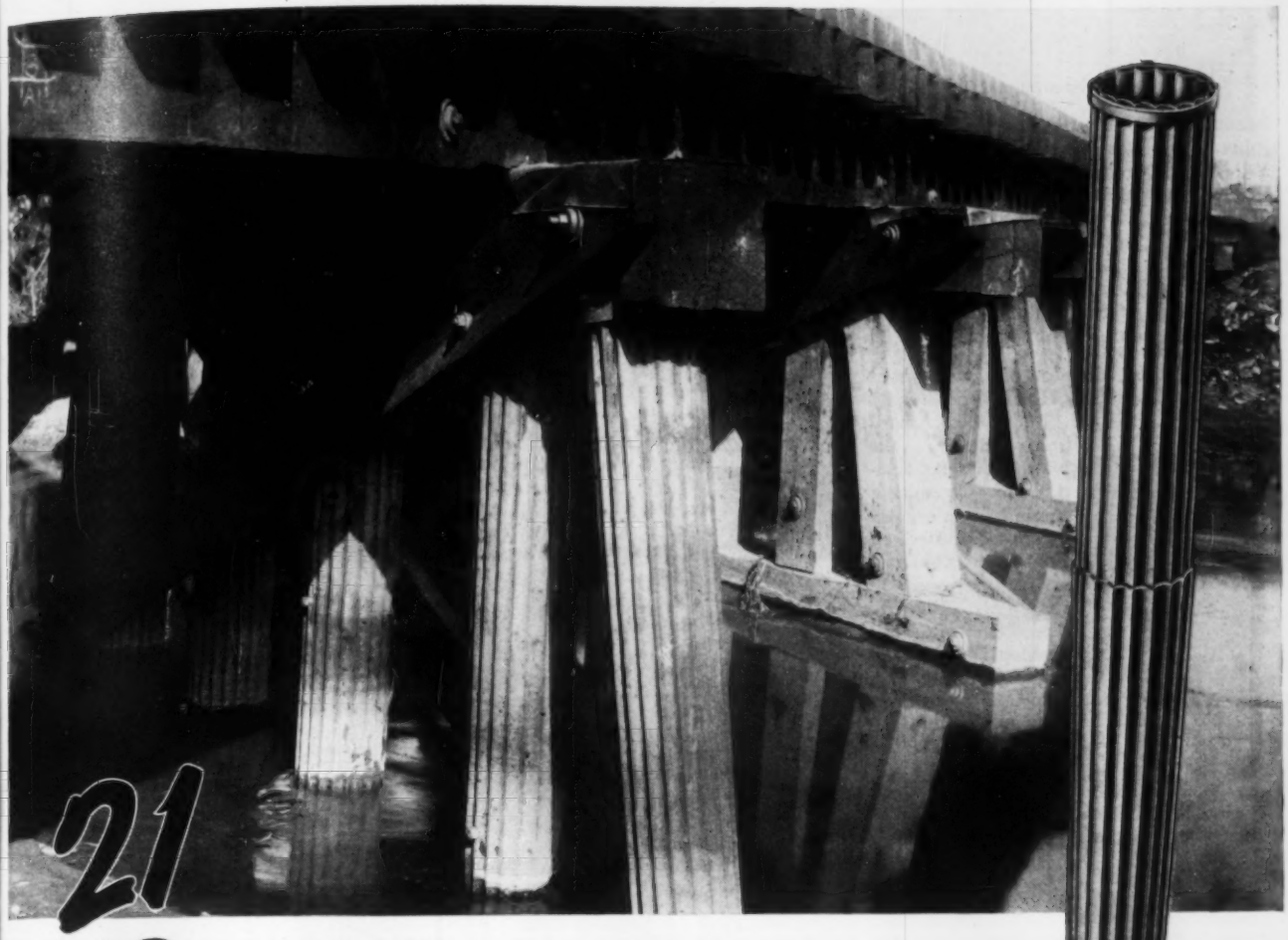
Florent H. Bailly, since 1928 with the Pantepec Oil Co., has been elected to the presidency of Pantepec Oil Co., C.A., and Pancoastal Oil Co., C.A., of Venezuela. Active in the engineering and geological departments of the organization, he has been chief engineer and chief geologist for the past 11 years.

F. Stuart Bennett, until recently engaged in private practice under the firm name of Means & Bennett, civil and structural engineers, has joined the Ralph M. Parsons Co., Atomic Energy Commission Project, as supervising engineer in charge of the civil engineering department. Headquarters of the project is the Santa Fe operations office at Los Alamos, N.Mex.

Leslie Weber Bollman, engineer in charge of weir and channel construction on Merriman Dam, under construction by the New York City Board of Water Supply, was one of 13 alumni of Cooper Union School of Engineering selected by the faculty to receive a degree of professional civil engineer.

Rolf Eliassen, since 1946 professor of sanitary engineering and director of the sanitary engineering research laboratory at New York University, has resigned to accept an appointment as professor of sanitary engineering at Massachusetts Institute of Technology. In addition to graduate work in the civil engineering course he will supervise a research program in the analysis, purification, and disposal of industrial wastes, as well as studies in water supply contamination and purification.

(*Continued on page 70*)



~~18~~ *years* of Service...and still going strong! MONOTUBE Foundation Piles

IN 1928 the first tapered steel Monotube foundation piles were installed on one complete bent of a Wheeling and Lake Erie Railroad trestle bridge. Recently Union Metal engineers made a thorough inspection of that first Monotube piling job. They found it in excellent condition —*ready to serve for years to come.*

Monotubes are preferred by engineers and contractors because . . .

Monotubes are light in weight, easily and quickly handled • They are cold-rolled and fluted for extra strength • They are easily extendible, right on the job • Their sturdy construction makes it possible to eliminate use of a driving mandrel • Monotubes' tubular construction makes inspection, before concreting, quick and easy.

Right now you may be planning bridges, highways, underpasses, buildings. Wherever foundation piling is necessary, plan on Monotubes. They give your projects the right start and a healthy future —make time and cost savings for you. Gauges, sizes and tapers to meet varying soil conditions. For complete information, write The Union Metal Manufacturing Company, Canton 5, Ohio.

UNION METAL

Monotube Foundation Piles

(*Continued from page 68*)

Francis S. Friel, president of the Philadelphia, Pa., consulting firm of Albright & Friel, recently received an honorary doctor of engineering degree from Drexel Institute of Technology. Dr. Friel was cited for his "notable contributions to the health and property of our people through his skill in sanitary technology, and to the security and well-being of our country through his public service in peace and war. . . ."

John P. Riley, director of development for the New York City Housing Authority, is the recipient of the First Annual Award presented by the New York Association of Consulting Engineers–an organization composed of 40 consulting firms in the metropolitan area. Mr. Riley received the award for his contributions to the engineering profession and for fostering the aims and objectives of the Association. Since 1939, he has been affiliated with the New York City Housing Authority, having had charge of the construction of 43 permanent housing projects.

John P. Riley

Charles N. Gaylord, until recently professor of structural engineering and assistant dean of the University of Alabama College of Engineering, has accepted an appointment as chairman of the department of civil engineering at the University of Delaware. Professor Gaylord will assume his new position on September 1.

Walter K. Wilson, district engineer for the Army Corps of Engineers at St. Paul, Minn., has been transferred to the Mobile, Ala., District.

Gordon R. West, consulting engineer, announces the opening of an office for the practice of civil engineering in Houston, Tex., with specialties in the investigation and execution of industrial and land developments.

Officers of the newly organized Arizona section of the American Welding Society include ASCE members **Ralph A. Hoffman,** bridge engineer for the Arizona Highway Department, who will serve as chairman; and **Walter Earl Riley,** structural engineer of the Allison Steel Manufacturing Co., of Phoenix, who will act as technical representative.

William C. Klett, of Houston, Tex., is now in the Southwest Texas Division office of the Humble Oil Co., as senior civil engineer.

Grant P. Gordon resigned as regional engineer of the Pacific Northwest headquarters of the Bureau of Reclamation to become connected with the Guy F. Atkinson Co., San Francisco, Calif., contractors. Mr. Gordon became affiliated with the Bureau in 1927 and was made regional director in 1947.

Dwight L. Glasscock will assume new duties as assistant professor of hydraulic engineering at Louisiana State University in September. Previously Professor Glasscock was employed by the Aluminum Company of America on the design of various hydroelectric developments.

Revoe C. Briggs was recently appointed district engineer for the Surface Water Branch, Water Resources Division, of the U.S. Geological Survey at San Francisco, Calif., succeeding Harry D. McGlashan, who has retired. Mr. Briggs has served the Water Resources Division for the past 32 years, many of which were spent as Mr. McGlashan's principal assistant.

Ellsworth I. Davis, formerly assistant district engineer for the Corps of Engineers at Sacramento, Calif., has assumed new duties as district engineer of the Galveston, Tex., District. In this capacity, Colonel Davis will administer a $50,000,000 construction program.

Carl B. Wirsching, who recently resigned from the post of city manager of Long Beach, Calif., has accepted the appointment of city manager of Hawthorne, Calif.

Robert Edward Lee, of Limestone, Me., has been appointed resident engineer for the Navy Civil Engineer Corps at Meridian Dam on the Middle Fork of the Willamette River, with headquarters at Lowell, Ore. Mr. Lee was transferred from the New England Division of the Corps at Boston, Mass.

Thomas C. Hanson, who recently resigned as Detroit, Mich., commissioner of Public Works, has become a member of the civil engineering firm of Mason L. Brown & Son, also of Detroit. He will retain the position of president of the Detroit Rapid Transit Commission. Prior to his 17 months' service as commissioner, Mr. Hanson was head of the department of civil engineering at the University of Detroit.

R. J. Newell, director of Region 1 for the Bureau of Reclamation at Boise, Idaho, has retired. In 1943 when the Bureau was reorganized into regions, Mr. Newell was appointed assistant regional director of the Columbia River Basin, and in 1945 was named director.

Gerald A. Fleet was recently named district manager of the American Well Works, with headquarters in New York City. Mr. Fleet served as a major in the Sanitary Corps of the Army during World War II.

George Simpson Armstrong, New York consultant, was presented with an Alumni Meritorious Service Award for his service to New York University at recent commencement ceremonies there.

Ralph Earle has been elected an alumni trustee of Rensselaer Polytechnic Institute. A graduate of the class of 1924, Mr. Earle is president and treasurer of the Philadelphia, Pa., construction company of Thomas Earle & Sons, Inc.

Leslie Newman McClellan, chief engineer for the Bureau of Reclamation at Denver, was recently awarded the honorary doctor of engineering degree by the University of Colorado at the school's commencement exercises in Boulder. As chief engineer, Mr. McClellan has direct responsibility for the planning, research, design, and construction phases of the reclamation program in the United States.

Albert Haertlein, former Director of the Society, and Gordon McKay, Professor of Civil Engineering at Harvard, received an honorary doctor of science degree from Northeastern University in Boston at commencement exercises on June 26. His citation read, "Distinguished civil engineer, authority in the design of structures, counsellor to aspiring youth, you have committed your talented mind and generous heart to the advancement of a great profession. Northeastern is happy to recognize a prodigious worker whose selfless spirit evokes admiration and affection among colleagues throughout the field of engineering."

Albert Haertlein

Ralph A. Tudor, a colonel in the Engineer Reserve and chief of the Division of San Francisco Bay Toll Crossings, has been selected to command a Brigade of Engineers in California—largest in the Engineer Reserve Program and fourth of twelve to be established throughout the United States. Composed of construction, port and aviation groups, service and maintenance units, the Brigade is being sponsored by the California State Department of Public Works at the Army's request.

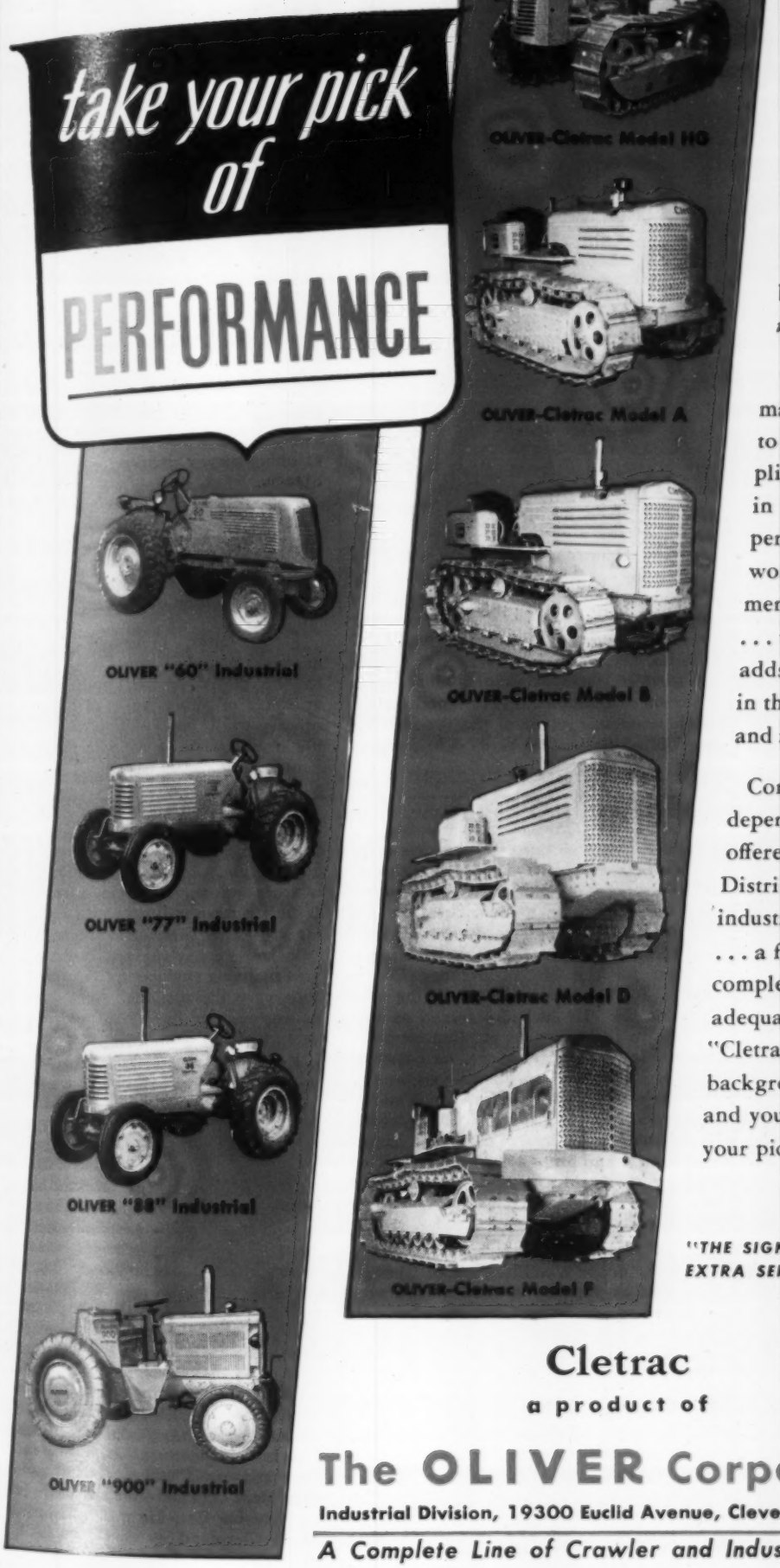
J. P. H. Perry, who has been vice-president in charge of new business with supervision of contract negotiations for the four regional offices of the Turner Construction Co., with headquarters in New York City, is now vice-president and consultant on new business.

C. Adrian Sawyer, Jr., president of the Sawyer Construction Co., of Boston, has been elected president of the Massachusetts Institute of Technology Alumni Association. Mr. Sawyer has been active in several construction firms in the Boston vicinity since 1903, and is on the advisory committee of the Massachusetts State Board of Health.

William J. Bobisch and **Charles P. Morgan** announce the formation of a partnership under the firm name of Morgan & Bobisch, Consulting Engineers, with an office at Long Beach, Calif. Mr. Bobisch was formerly employed as a senior civil engineer in charge of special studies and analyses for the U.S. Engineer Office at Omaha, Nebr. Mr. Morgan was superintendent of the Department of Building and Safety for the City of Long Beach, Calif.

(*Continued on page 72*)

take your pick of PERFORMANCE



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(*Continued from page 70*)

Laurence T. Gaylord, president of the Atlantic, Gulf and Pacific Co., the North Atlantic Dredging Co., and the National Association of River and Harbor Contractors, and vice-president of the Gaylord Construction Co., recently received an Alumni Merit Award from the Iowa State College Alumni Club of Chicago. The awards go to outstanding alumni for "meritorious service in their fields and contribution to their fellow men."

Daniel Kennedy, division engineer of the Central Division of the U.S. Geological Survey, at Rolla, Mo., was awarded the honorary degree of doctor of engineering at the Missouri School of Mines and Metallurgy commencement ceremonies. Dr. Kennedy was formerly chief of the Operations and Planning Staff of the Army Map Service.

Henry Tebow, acting progress officer of Region 7 of the Bureau of Reclamation at Denver, Colo., received the professional degree of civil engineer from the University of Illinois at its recent commencement ceremonies.

James Donaldson has resigned as city engineer of Menomonie, Wis., to engage in the contracting field with his brother.

Samuel Morris, general manager and chief engineer of the Department of Water and Power of Los Angeles, Calif., has been elected to the presidency of the Public Power Association, a national organization.

Benjamin C. Fowlkes, Jr., has been appointed district engineer of the Vicksburg, Miss., office of the Corps of Engineers, succeeding R. G. Lovett. Colonel Fowlkes recently completed a year of advanced study at the Industrial College of Armed Forces, Fort McNair, Washington, D.C. During World War II he commanded civil engineer units in the Southwest Pacific Theater. While serving in the Pittsburgh District, he was in charge of construction operations, as well as responsible for the Tygart River Reservoir Project at Grafton, W.Va.

Col. B. C. Fowlkes

Maxwell R. Warden, of Fairfield, Conn., has been promoted to the position of assistant general manager of the Remington Arms Co., at Bridgeport. Mr. Warden is also serving as vice-president of the company.

Cherry Emerson, dean of the school of engineering of the Georgia Institute of Technology, was awarded the Armin Maier Silver Cup for the most outstanding community service in the Rotary Club of Atlanta, Ga. The presentation was made at a recent rotary club luncheon. Dean Emerson's assistance in the preparation of the economic report of the President of the United States has given him national recognition.

Park H. Martin, executive director of the Allegheny Conference on Community Development, was recently presented with the honorary degree of doctor of engineering by the Carnegie Institute of Technology. A graduate of CIT, Mr. Martin practiced civil engineering before becoming, successively, chief engineer and assistant director of the Allegheny County Department of Works, planning engineer in charge of the County Department of Planning, and then director of the department.

E. H. Bruntlett has become connected with the St. Paul, Minn., consultant, Ealy G. Briggs.

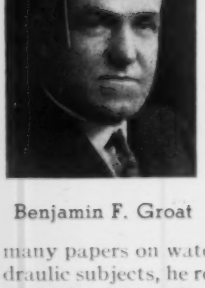
The Montana State Highway Commission recently held a reorganization meeting, at which it was announced that **Albert W. Jones,** formerly bridge plans engineer, will be bridge engineer, succeeding **Howard W. Holmes;** and **Albert W. Greiner,** previously associate construction engineer, will be planning survey engineer, succeeding **M. J. Steere.**

Wendell E. Johnson, until recently chief of the Engineering Division of the Omaha, Nebr., District of the Corps of Engineers, is now head of a similar department in the Missouri Division office.

J. V. Otter, previously Idaho commissioner of public works, has been named to the newly created position of commissioner of public works of Boise City to supervise all construction in that city. For several years he was with the Morrison-Knudsen Co., as an engineer.

Deceased

Benjamin Feland Groat (M. '13) consulting engineer, inventor and patent attorney, of Philadelphia, died in Hightstown, N.J., on June 16, at the age of 82. An alumnus of the University of Minnesota, Mr. Groat taught in the School of Mines there from 1898 to 1910, and from the latter year until 1920 was a hydraulic engineer with the Aluminum Co. of America. He developed precise turbine engine tests and methods of measuring water chemically. Author of many papers on water power and other hydraulic subjects, he received the silver medal of the Engineers Society of Western Pennsylvania in 1915 and the Norman Medal of the ASCE in 1917. He belonged to the American Society for Engineering Education and the American Mathematical Society.



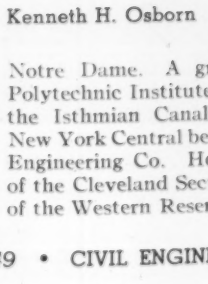
Benjamin F. Groat

Herbert Sidney Austin (Assoc. M. '19) consultant on the construction of overseas oil-storage and pipeline projects, with offices in New York City, died at Easton, Md., on July 5. Mr. Austin, who was 65, was fatally stricken while traveling to his home in Elizabeth, N.J., by motor. An authority on oil pipeline construction, Mr. Austin had been president of the Tuscarora Oil Co., Ltd.; coordinator of the Standard Oil Co. (New Jersey) systems; field superintendent for the M. W. Kellogg Co. in Aruba, B.W.I.; and president of the Ajax Pipeline Co. He had also served as consultant to the Navy on pipeline construction in Iceland, to the Army on construction of its Iranian pipeline project, and to the Petroleum Coordinator for National Defense. He was the recipient of decorations from several foreign countries, including France and Iraq. A graduate of Cornell University, Mr. Austin taught there and engaged in bridge and subway construction before entering the pipeline field.

Max Blatt (Assoc. M. '09) secretary-treasurer for the Woolf Realty Co., Chicago, Ill., died on January 4, according to word just received at Society Headquarters. He was 68. A native of Germany, Mr. Blatt was educated at Cooper Union in New York City and spent his early career with the New York City Department of Water Supply, Gas and Electricity. Later he was engaged on the installation of a high-pressure fire system for Manhattan, involving the laying of 25 miles of mains and construction of the necessary appurtenances. He had been connected with the Woolf Co. for more than 20 years at the time of his death.

Henry Morrison Chapin (M '27) engineer of Bala-Cynwyd, Pa., died on June 15. Mr. Chapin, who was 70, was for a number of years construction engineer for the Philadelphia Bureau of Engineering and Surveys. He had also been assistant engineer for WPA for Pennsylvania at Harrisburg, and area planning engineer for the Public Work Reserve at Philadelphia. In his early career he was engaged in railroad work—for some years with the New York Central.

Kenneth Howard Osborn (M. '20) vice-president of the Osborn Engineering Co., Cleveland, Ohio, died at his home in that city on June 25, at the age of 63. Projects carried out by his company, which specialized in stadia design, included the stadium at New York's Polo Grounds, Cleveland's Municipal Stadium, Soldier Field in Chicago, and football bowls at Harvard, the University of Michigan, and Notre Dame. A graduate of Rensselaer Polytechnic Institute, Mr. Osborn was with the Isthmian Canal Commission and the New York Central before joining the Osborn Engineering Co. He was a past-president of the Cleveland Section of the ASCE and of the Western Reserve Society.



Kenneth H. Osborn

Edward Marshall Craig, Jr. (M. '47) civil engineer for the New York City Board of Water Supply, New York, died suddenly on June 9. Mr. Craig, who was 53, had been on the New York City engineering staff in various capacities since 1926. Prior to that, he had been with the Newark, N.J., Division of Water; the North Jersey District Water Supply Commission; and the Alabama State Board of Health. A graduate of Yale University, with graduate degrees from MIT and Johns Hopkins University, Mr. Craig taught for several years before entering the field of water supply. He served as an ensign in the Navy in World War I.

Warrick Rigeley Edwards (M. '10) retired engineer of Baltimore, Md., died in January 1949, according to a recent notification. He was 80. Beginning in 1894, Mr. Edwards was for a number of years with the Baltimore & Ohio Railroad, which he served as assistant bridge engineer, chief bridge draftsman, and engineer of bridges. Later he was senior structural engineer for the Bureau of Valuation of the Interstate Commerce Commission, with headquarters in Washington, D.C.

Paul Jones Essick, Jr. (M. '42) deputy chief of the Philadelphia Bureau of Highways and Street Cleaning, died at his home in Philadelphia on June 16. He was 60 and a graduate of the University of Pennsylvania. Mr. Essick became connected with the Bureau of Highways in 1912, and was appointed deputy chief about 20 years ago. A veteran of World War I, he had been active in the American Legion and the Philadelphia Municipal Employees War Veterans Association and in Masonic activities. He also belonged to the American Road Builders Association.

James Henry Fitzgerald (Assoc. M. '19) president of Fitzgerald & Hudson, a New York construction equipment company, died in a hospital in Plainfield, N.J., on June 16, at the age of 64. His home was in Westfield, N.J. Before forming his own firm, Mr. Fitzgerald was manager of the Ransome Concrete Machinery Co., New York City. His earlier experience included work for the Degnon Contracting Co. and Booth & Flinn on several Catskill Aqueduct contracts, and as office engineer on design of the Passaic Valley Sewer. Mr. Fitzgerald was one of the founders of the Moles, New York Society of heavy construction men.

Arthur Willard French (M. '04) professor emeritus of civil engineering at Worcester Polytechnic Institute, Worcester, Mass., died in a hospital there on May 27, at the age of 80. An alumnus of the Thayer School of Engineering at Dartmouth, with a graduate degree from WPI, Professor French was on the teaching staff of the Institute for 39 years prior to his retirement in 1938 with the rank of professor emeritus. He was also prominent in consulting and research fields, and did pioneer work in reinforced concrete. Professor French was a member of American Society for Engineering Education, the Boston Society of Civil Engineers, and the Worcester Society of Civil Engineers.

(*Continued on page 74*)

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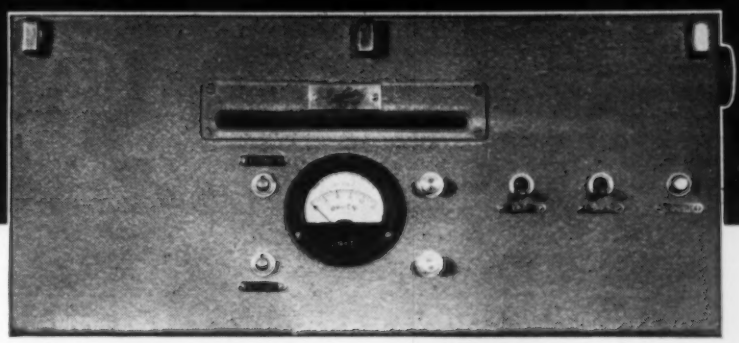

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(*Continued from page 73*)

George Elmer Hogan (Assoc. M. '41) engineer of Palo Alto, Calif., died on February 9, according to word just received at Society Headquarters. He was 60. Mr. Hogan had been sales engineer for the General Electric Co., in San Francisco; owner's representative on a large program of reconstruction in Portland, Ore.; supervisor of an extensive program of school building in San Jose, Calif.; and designer at the San Francisco plant of the Bethlehem Steel Co. More recently he was chief engineering inspector for the Austin Co., at Seattle.

Samuel Reynolds Jones (Assoc. M. '09) vice-president and director of the J. G. White Engineering Corp., New York City, died at his home in Cranford, N.J., on June 18, at the age of 70. Following his graduation from the University of Pennsylvania in 1899, Mr. Jones was employed as structural draftsman for the Phoenix Bridge Co. and estimator for American Bridge Co. From 1906 on, he was connected with J. G. White Engineering Corp., which he served as structural engineer and engineering manager before his appointment as vice-president and director in 1932.

Chester Allen Hogentogler (Assoc. M. '22) retired chief of the Soil Mechanics Research Division of the Public Roads Administration, died at his home in Washington, D.C., on June 18. He was 62. A graduate of Pennsylvania State College, Mr. Hogentogler taught engineering at the University of Idaho for several years before going to the PRA. From 1929 until his retirement in 1947, he headed the research Division of the PRA. An authority on soil mechanics, Mr. Hogentogler had served as chairman of numerous soils and allied committees for the American Society for Testing Materials, the American Road Builders' Association, and the American Association of State Highway Officials. Author of *Engineering Properties of Soil* and other widely used texts, Mr. Hogentogler had received the Dudley Award of the ASTM and the Bartlett Award of the ARBA.

C. A. Hogentogler

Edgar Kingsbury Ruth (M. '19) general housing manager for the Cincinnati Metropolitan Housing Authority since 1946, died in Cincinnati on May 19, at the age of 63. An alumnus of Dakota Wesleyan University and Rensselaer Polytechnic Institute, Mr. Ruth was assistant professor of civil engineering at the University of Cincinnati from 1916 to 1920, except for a brief period as captain of Engineers in World War I. He was plant engineer for the American Oak Leather Co. from 1920 to 1939, and had been with the Cincinnati Housing Authority since 1941. Mr. Ruth was a life member and past-president of the Engineering Societies of Cincinnati.

(*Continued on page 80*)

Program Develops Mexico's Water Resources for Irrigation

(*Continued from page 32*)

Barona stated that it accounts for 12.4 percent of the total funds appropriated for irrigation construction. This percentage would be larger except that most of the dams are of the earth and rockfill type and the canals are unlined. During the 23-year life of the federal reclamation agency, he said, efforts have been made to secure better cements and use them more efficiently so as to increase the purchasing power of the funds.

Before 1926, when the present reclamation program was started, there were only five cement plants in Mexico, with a total yearly production of about 879,000 bbl. The cement produced at that time, he stated, had in general high percentages of tricalcium aluminate (up to 13 percent) and free lime (3 percent), rather low percentages of tricalcium silicate (30 percent) and a low fineness (85 percent passing the 200 mesh). Magnesia has always been low in Mexican cements, he said.

At the same time, Mr. Barona declared, cement in the United States had a similar percentage of tricalcium aluminate but higher early strength because of finer grinding and higher tricalcium silicate (about 45 percent).

Today Mexico has 18 cement plants with 45 operating kilns producing 7,618,000 bbl yearly. Of these plants 11 add iron ore to the raw mix to reduce tricalcium aluminate and facilitate burning; 8 produce low-alkali cement (less than 0.6 percent); and 15 add gypsum to suit the specific requirements of their cements.

Referring to the construction of Rodriguez Dam in Lower California, a buttress and slab structure, the author said that work was started in 1928 using American cement that hydrated at a fast rate and produced a temperature rise of 30 deg F. Cracks appeared in the buttresses when the cement cooled. The Don Martin Dam spillway, a roundhead buttress structure built at about the same time, using Mexican cement having a slow rate of hydration, suffered much less cracking. Tests made at Rodriguez Dam comparing temperature rises obtained with different types of cement showed that the rise was higher for cements high in tricalcium salts (silicate and aluminate). These results and the knowledge gained from Hubert Wood's research at the Riverside cement plant brought about the decision to use low-heat cement at the Rodriguez Dam, Mr. Barona said.

At Mexico's Angostura Dam in 1936, he said, the tricalcium silicate content of the cement produced by the wet process was controlled to provide cement "a la carte," according to the prevailing temperature. In the winter this content was kept at 26 to 28 percent and in hot weather at 20 to 24 percent. The cement had a high silicate content (dicalcium plus tricalcium equaled 75 to 78 percent) and passed ASTM specifications not only for Type IV (low heat) but also for Type V, (sulfate resistant). To grout the vertical contraction joints at the lowest expected temperature, cool water was circulated through coils embedded in the concrete, he further explained.

Efficient cement of the modified type was used to advantage in Mexico in the Lazaro Cardenas and Marte Gomez Dams (1838–1946), the author stated. At the latter dam a natural clay-sand-gravel material (Reynosa formation) mixed with a low proportion of cement (0.58 bbl per cu yd) was used to fill the interior of the free-crest spillway—the largest built in Mexico, 740,000 cfs. Lean concrete thus made attained at 28 days an average strength of 427 psi, he said, which although satisfactory, was rather low because of the clay content of the Reynosa formation. The outside of the spillway was cast with regular concrete (3,000 psi). For the free-crest spillway of the Alvaro Obregon Dam, under construction on the Yaqui River, a similar procedure will be followed, Mr. Barona said, using, instead of clay, an efficient air-entraining agent to provide about 3 percent of air, to give the lean mixes plasticity and higher strength, through the favorable catalytic action of the entraining agent.

Mr. Barona concluded his paper with a statement of the new specifications for portland cement which were adopted in Mexico in February 1948. These specifications changed the SO_3 requirement from a fixed limit of 2.5 percent for high early strength cement and 2 percent for other types, to a variable limit depending on the fineness, alkali and tricalcium aluminate contents. Other requirements regulate the thoroughness of burning, amount of free lime (below 2 percent, preferably below 1.5 percent), amount of alkalis (to be kept below 0.8 percent), use of a puzzolana addition to counteract alkali reaction, control of gypsum, and other ingredients.

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Western Projects Announced by Bureau of Reclamation

WORK IN PROSPECT on several large Western construction projects is announced by the Bureau of Reclamation in its *Advance Construction Bulletin* for July 1, under the head of "Bid Calls Expected This Month." Among these projects are the following:

PUMPING PLANTS
Gila Project, Arizona

Location: On Wellton-Mohawk Canal, about 20 miles east of Yuma, Ariz.

Work: Construction of three reinforced concrete pumping plants; installation of pumping, electrical, heating, and ventilating equipment, traveling cranes, and water and sewerage systems.

Excavation (all classes)	295,600 cu yd
Backfill	33,500 cu yd
Compacted backfill	16,200 cu yd
Furnishing and placing reinforcing steel	1,518,000 lb
Concrete	9,600 cu yd
Furnishing and driving timber piling	52,000 ft
Furnishing and laying 72-in. diameter reinforced concrete pipe	2,300 ft
Furnishing and laying concrete pipe (various sizes)	1,000 ft
Installing three traveling cranes	106,000 lb
Installing roofing and insulation	17,500 sq ft
Furnishing and installing electrical conduit (various sizes)	16,800 ft
Furnishing and installing conductor cables	7,600 ft
Furnishing and installing 600-volt insulated electrical wire	36,100 ft
Furnishing and installing ground conductors	8,400 lb
Time Allowed for Completion:	1,000 days

DELTA-MENDOTA CANAL
Central Valley Project, California

Location: Near Los Banos, Calif.

Work: Construction of earthwork, concrete lining, and structures for about 20 miles of Delta-Mendota Canal. The canal capacity varies from 4,200 cfs to 3,500 cfs.

Excavation for canal	5,250,000 cu yd
Excavation for structures	74,000 cu yd
Trimming for concrete lining	1,274,000 sq yd
Concrete in lining and structures	152,000 cu yd
Furnishing and handling cement	214,000 bbl
Furnishing and placing reinforcing steel	1,459,000 lb
Placing reinforcing steel furnished by government	117,000 lb
Furnishing and laying 15- to 36-in. diameter reinforced concrete pipe	9,400 ft
Furnishing and installing 12- to 36-in. diameter welded steel pipe	3,300 ft
Installing gates and gate hoists	157,000 lb
Time Allowed for Completion:	675 days

CAMBRIDGE CANAL
Missouri River Basin Project, Nebraska

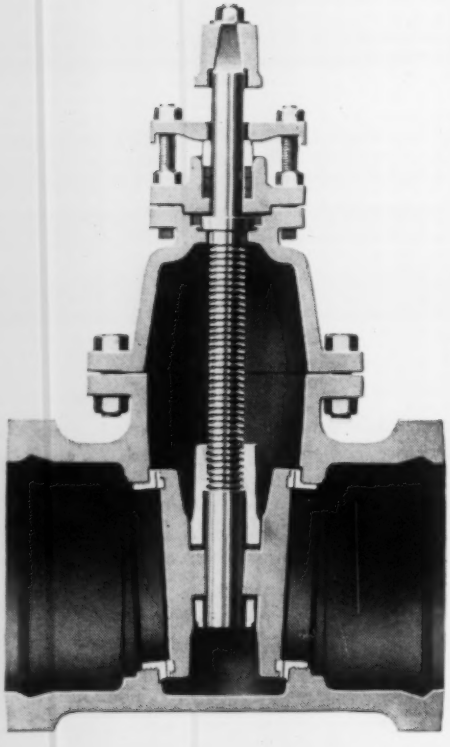
Location: About 40 miles northeast of McCook, Nebr.

Work: Construction of earthwork and structures for 6.5 miles of Cambridge Canal, 265 cfs capacity.

Excavation for canal	152,000 cu yd
Excavation for drainage ditches	73,000 cu yd
Excavation for core banks	20,500 cu yd
Overhaul	77,000 sta. yd
Free haul	750 ft
Concrete	3,550 cu yd
Furnishing and handling cement	5,360 bbl
Furnishing and placing reinforcing steel	455,220 lb
Furnishing and laying 18- to 60-in. diameter precast concrete pipe	2,780 ft
Time Allowed for Completion:	Not determined.

(Continued on page 78)

R. D. WOOD GATE VALVES stand on their RECORD



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The record of R. D. Wood Gate Valves inspires confidence. They have been demonstrating their reliability for generations—proving the soundness of their design. Only three moving parts—spreader and two discs. The discs are free to rotate their full circumference when raised and lowered—are not subject to wear at any one point. In closing, pressure is applied from the center, the discs seating tightly and without distortion. There are no pockets to collect sediment. Fully opened, the valve permits an unobstructed flow of water.

For the safety of your community, specify R. D. Wood Gate Valves, the gate valves with the record of dependability. Send for complete information today.

Seasoned castings. Rigidly inspected. For working pressures up to 175 lbs. Tested to 300 lbs. Conforming to AWWA specifications. Bell or flanged ends, or to connect with any standard type of joint. Sizes 2" to 30".

Be extra safe. Operate all valves at least once a year.

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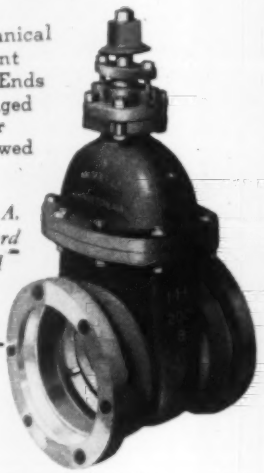
HYDRANTS & VALVES

Mechanical Joint Hub Ends Flanged or Screwed



A.W.W.A. Standard M & H Valve With Mechanical Joint

VALVES: A.W.W.A. type iron body, bronze mounted with double-disc parallel seat or solid wedge type. Non-rising stem, outside screw and yoke, or with sliding stem and lever. Also furnished hydraulically operated. Square bottom type operates in any position.

HYDRANTS: standard A. W.W.A. type approved by Underwriters and Factory Mutuals.

M & H PRODUCTS INCLUDE:

FIRE HYDRANTS
GATE VALVES
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WALL CASTINGS
SPECIAL CASTINGS
TAPPING SLEEVES
CHECK VALVES
FLOOR STANDS
EXTENSION STEMS
SHEAR GATES
MUD VALVES
VALVE BOXES
FLAP VALVES
SLUDGE SHOES
FLANGE AND FLARE FITTINGS
FLANGED FITTINGS
B & S FITTINGS
CUTTING-IN TEES

M&H VALVE

AND FITTINGS COMPANY

ANISTON, ALABAMA

Meetings and Conferences

American Institute of Chemical Engineers. A meeting of the American Institute of Chemical Engineers will take place at the Mt. Royal Hotel, Montreal, Canada, September 18–20.

American Institute of Electrical Engineers. Technical sessions, inspection trips, student activities, and social functions are featured during the Pacific general meeting of the American Institute of Electrical Engineers to be held at the Fairmount Hotel, San Francisco, Calif., August 23–26.

American Public Works Association. Long-range planning of public works will be one of the major topics of discussion at the 55th annual American Public Works Association congress and equipment show in Kansas City, Kans., September 18–21.

Association of Western State Engineers. The 22nd annual meeting of the Association of Western State Engineers will be held at Bismarck, N.Dak., August 22 through 25. Inquiries should be addressed to the Office of the President, Association of Western State Engineers, 1301 Capitol Building, Bismarck, N.Dak.

Illuminating Engineering Society. Significant lighting achievements of the past year will be reviewed during the national technical conference of the Illuminating Engineering Society at French Lick, Ind., September 19–23. The conference will be preceded by the annual lighting service forum on September 19.

Institute of Traffic Engineers. Headquarters for the annual meeting of the Institute of Traffic Engineers will be the Wardman Park Hotel, Washington, D.C., September 25 through 28.

Instrument Society of America. Latest developments in instruments are to be discussed and displayed at the fourth national instrument exhibit of the Instrument Society of America, which will take place in the St. Louis, Mo., Municipal Auditorium, September 12–16.

New England Water Works Association. The convention of the New England Water Works Association is scheduled for The Balsams, Dixville Notch, N.H., September 13–16.

Society of Automotive Engineers. Headquarters for the West Coast meeting of the Society of Automotive Engineers will be the Multnomah Hotel, Portland, Ore., August 15 through 17.

United Nations Scientific Conference. The United Nations Scientific Conference on the Conservation and Utilization of Resources will be held at the United Nations Interim Headquarters, Lake Success, N.Y., August 17–September 6.

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STEEL MEASURING TAPES

The man who knows and uses measuring tapes instantly recognizes the superiority of WYTEFACE "A" Steel Tapes. Raised black graduations and rims, on a crack-proof white surface, make these steel tapes as easy to read in the brightest glare as in the dimmest light. See WYTEFACE "A" heavy duty and general purpose steel tapes at your dealer's, or write for catalogue.

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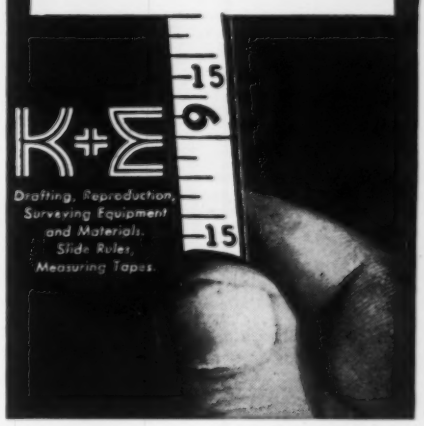

(*Continued from page 76*)

GERING SUBSTATION ADDITIONS

Missouri River Basin Project, Nebraska

Location: Gering, Nebr.

Work: Construction of additions to the Gering Substation, including installation of the following items of equipment: three 3,333-kva single-phase, 115- to 34.5-kv transformers; four 115-kv oil circuit breakers; one 34.5-kv oil circuit breaker; two 115-kv potential transformers; switches; lightning arresters; etc.

Excavation	3,650 cu yd
Compacted backfill	1,050 cu yd
Concrete	575 cu yd
Furnishing and handling cement	860 bbl
Furnishing and placing reinforcing steel	34,000 lb
Erecting structural steel	225,000 lb
Furnishing and erecting extension to chain link fence	820 ft
Removing portion of existing chain link fence	420 ft
Furnishing and placing gravel	185 cu yd

Time Allowed for Completion: 210 days

Engineering Societies PERSONNEL SERVICE, INC.

NEW YORK 8 W. 40th ST. • CHICAGO 84 E. RANDOLPH ST. • DETROIT 100 FARNSWORTH AVE. • SAN FRANCISCO 57 POST ST.

Men Available

EXPERT STRUCTURAL ENGINEER; Assoc. M. ASCE; C.E., P.E. (N.Y.); Assoc. S.C.C.E.; 35; specialist in unusual problems; heavy reinforced concrete, structural steel, structural timber; 15 years' experience includes industrial plants, office buildings, roads, dams, oil refineries, drydocks, power plants. Salary or retainer basis. C-509.

ARCHITECTURAL ENGINEER; Assoc. M. ASCE; 32; married; 12 years' experience, field and office, on buildings, seawalls, public works and water conservancy; 3 years in Orient as conservancy and consulting engineer on irrigation and water control projects. Familiar with operation and maintenance of heavy construction equipment. Speaks German and some Chinese. Available August 15. C-510.

CIVIL ENGINEER; Assoc. M. ASCE; many years' work in Mexico, Puerto Rico, Venezuela, and Chile in mines, oil refineries, steam power plants, handling construction, transportation, housing, pipelines, maintaining camps, etc. Engineering training at University of Georgia. Speaks, reads, and writes Spanish. C-511.

CIVIL ENGINEER; Jun. ASCE; B.S. in C.E., 1941; graduate work in geodetic surveying; 30; married. French and Spanish; 8 years' varied engineering experience—recently chief field engineer on large project, including construction of large plate-girder bridge, highway, and various buildings and utilities. Desires position in heavy construction field. Prefers eastern U.S., but will consider other locations. Available immediately. C-512.

CIVIL ENGINEER; Jun. ASCE; B.S. degree; 25; married; 2 years' experience as construction engineer and chief of party on land development. Will go anywhere. C-514.

CONSULTANT, MANAGER, CHIEF ENGINEER, GENERAL SUPERINTENDENT; Assoc. M. ASCE; registered professional engineer; 43; married; fluent Spanish; 20 years tropical residence. Successful executive background in oilfield development, public works, roads, pipelines, brick plants, housing, and industrial developments. Planning, designing, estimating, constructing, and operating. Able negotiator. Will go anywhere. Available soon on salary, fee, or contract basis. C-515.

LICENSED PROFESSIONAL ENGINEER in Indiana and Illinois; M. ASCE; college graduate; single. 25 years' experience in structural steel, plate work and pressure vessel design and fabrication; welding, reinforced concrete as Chief Draftsman, Welding Engineer, Assistant Chief Engineer, and Chief Engineer. Geographical location of employment unimportant. C-516.

CIVIL ENGINEER; Jun. ASCE; 29; married. M.S. in C.E. (obtaining C.E. degree August 1949) Stanford, Phi Beta Kappa, Tau Beta Pi. Desires work in structural design. Available September 1949. Prefers California. C-517.

Positions Available

ESTIMATOR for building contractor. Must have had at least 10 to 15 years' experience in public works construction. Duties will include quantity take-off, pricing with the assistance of the information given by employer, good erecting jobs, and taking care of details. Salary, $5,200–$6,500 a year. Permanent. Location, South. Y-2207.

This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient non-profit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

ASSISTANT ENGINEER, civil engineering graduate, with training in surveying fundamentals and methods and 2 years of practical experience in surveying. Experience in precise surveying and leveling is desired. Will act as chief of party. Must own car. Salary, $3,000–$3,600 plus car expenses. Should be resident of New Jersey. Y-2222.

PARTY CHIEF, about 30, single, preferably civil graduate, with industrial construction experience, to lay out oil refinery buildings, structures, pipelines, roads, etc. Knowledge of Spanish desirable. Two-year contract. Salary, $5,400 a year plus expenses and bonus. Location, Venezuela. Y-2269.

CHIEF DRAFTSMAN, 35–50, structural design background with broad supervisory design experience on tunnels, bridges, harbors, and municipal work with Southern engineering firm. Salary commensurate with ability. Y-2272.

SANITARY ENGINEERS. (*a*) Sanitary Engineer, State Department of Health, degree in sanitary engineering, with at least 6 years' sanitary engineering experience, 2 of them in responsible charge. Starting salary, $5,000 a year, retirement plan, and civil service. (*b*) Senior Assistant Sanitary Engineer, degree in sanitary engineering, with at least 4 years' experience in sanitary engineering. Positions started about July 1, 1949. Salary to start, $4,246 a year. Location, East. Y-2282.

INSTRUCTOR, master's degree in civil engineering, preferably with some teaching experience, to teach civil engineering courses. Position starts in the fall. Salary, $3,000 for 9 months, with possibility of summer teaching at the rate of $1,000, for the quarter. Location, Georgia. Y-2382.

FIELD ENGINEER, civil or mining graduate, with stripping or other earthmoving experience, to supervise and lay out shovel and other excavating schedules, etc. Salary, $3,600–$4,200 a year. Location, West Virginia. Y-2519.

RESIDENT ENGINEER to take complete charge of all engineering work as well as superintendent of construction in the field on large express highway construction. Should have considerable experience on tunnels, bridges, paving, heavy earth, and rock work. Knowledge of Spanish desirable. Salary, $18,000–$20,000 a year. Location, South America. Y-2567.

TEACHING PERSONNEL. (*a*) Professor in Civil Engineering, doctor's degree desired, to teach graduate courses or advanced senior courses in structures, and to lead research work. (*b*) Lecturer in structural engineering. Work will include creative writing and research, with some teaching as desired. Location, South. Y-2591.

ENGINEERS, about 30 years of age, civil graduates, who have had highway and airport construction experience, to work in laboratory on inspection of highway and airport paving. After a few months' training, will be placed as sales engineers to promote and supervise the use of asphaltic products. Location, South Atlantic States. Y-2599.

CHIEF ENGINEER, 35–40, civil graduate, to direct large public works operations in connection with sewers, streets, sanitation. Should have good knowledge of building construction. Must be the highest type of executive engineer. Salary, $10,000 a year. Location, South. Y-2600.

ASSISTANT DIRECTOR OF ENGINEERING, 35–45, mechanical or civil degree, with knowledge of food processes, plant maintenance. Must have 12 years' experience. Will coordinate specialized design work on machines, and equipment; designate types and quality of materials to be used in engineering projects; originate and suggest methods and method improvement. Keep records of work being performed and jobs to be done—drawing and specification files. Will contact contractors, supplies, and engineering firms. Must be able to supervise engineers. Salary $7,000–$8,500 a year. Location, Minnesota. Y-2602.

INSTRUCTORS OR SENIOR INSTRUCTORS, graduates, with 2 years' experience. Structural Technology, graduate, with structural experience, teaching background desirable. Starting salary $3,277 a year, with yearly increment of $150 and promotional possibilities. Location, New York Metropolitan area. Y-2617.

FIELD ENGINEER, graduate, architectural or civil engineer, 27–35, several years' experience in construction or manufacture and distribution of concrete products, such as building units, pipe or tile. Will do considerable contact work with products' manufacturers, builders, architects, etc. Should be fairly good extemporaneous speaker and better-than-average writer. Salary open. Location, Chicago, Ill. R-5743.

ARCHITECT, graduate of recognized school, 30–45. Substantial general architectural experience, particularly that related to school and commercial buildings. Licensed or able to qualify for Illinois license; will be occupied with all phases of architectural duties and should be capable of engaging in the general business of running an architectural office for an established architect. Salary, approximately $8,000 a year. Location, Illinois. R-5751.

"Stop shivering, Ruth!
I'll have some more water hot in a minute"

Fifty years ago, a tea-kettle provided hot water for the Saturday night bath in many homes. Today, over 12 million automatic gas water heaters are in use and 21 million homes are served by gas for cooking, refrigeration and heating. The extraordinary growth and expanded availability of gas service is a notable contribution to better living in America.

Water supply and sanitation have also made remarkable progress in the half-century since 1899, the year our Company was organized. Today, more than 12,000 water works permit inside plumbing and furnish a dependable supply of safe, potable water, for 85 million people. Over 6,000 sewage treatment plants, now in operation, help protect the health of more than half of our urban population.

For 50 years we have been the largest producer of cast iron pressure pipe and fittings for these public services, so vital to better health and living. We are happy to have contributed to some extent to their progress. As to progress on our account—in manufacturing methods, production standards and quality controls—let our present product speak for itself.

To those responsible for the great progress in water supply, gas and sanitation service and their contribution to better health and living over the past fifty years, America pays tribute.

U.S. CAST IRON PIPE

1899-1949
U. S. Pipe & Foundry Co.
Makers for 50 years of cast iron pipe for water, gas and sewerage service.
General Offices: Burlington, N. J.

(*Continued from page 74*)

Frank Eddy Waterman (M. '28) civil engineer of Providence, R.I., died at his home there on June 28, at the age of 79. Mr. Waterman established his own engineering practice, under the name of the Waterman Engineering Co., in 1894. For 19 years he also served as Providence city engineer and commissioner of public works, relinquishing these posts in 1933.

William D. Wiggins (M. '13) retired vice-president in charge of engineering for the Pennsylvania Railroad, died at Bryn Mawr, Pa., on June 12, at the age of 76. His home was in Merion, Pa. Mr. Wiggins became connected with the Pennsylvania Railroad immediately following his graduation from Rose Polytechnic Institute in 1895. He was promoted through the various grades, becoming superintendent of the Peoria Division in 1912 and chief engineer of the system in 1935. At the time of his retirement in 1943, he was vice-president of engineering.

Frank Albert Woodyard (Assoc. M. '32) construction engineer of Monterrey, Mexico, died in a hospital there on May 27, at the age of 50. A native of West Virginia, Mr. Woodyard went to Mexico in 1923 to become connected with the construction firm of J. F. Woodyard & Son. He had been a member of the firm since 1928. Mr. Woodyard was educated at the Texas School of Mines and the University of Southern California, and was a veteran of World War I.

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FOR PUMPED WATER SYSTEMS Constant Rate Feeder — Heavy Duty Midget Chem-O-Feeder. Feeds 0-7½ GPH at 0 to 85 p.s.i.

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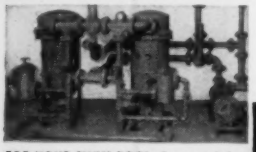
FOR YOUR CAMP Du-Self — a complete Package Unit—for water treating. For flows up to 25 GPM and 75 p.s.i.



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NEW IMPROVED CHEM-O-FEEDER

MODEL 1-47

This new Heavy Duty Chem-O-Feeder has many added features for precision control and easier maintenance. Stroke length is instantly adjustable by turning a knob while pump is operating — a magnifying register glass shows exact reading in thousandths of an inch over a range from 2 to 13 cc per stroke. The new Model 1-47 has convenient oil fill and handy sight gauge — all moving parts operate in an oil bath. Plastic "See-thru" reagent head handles any chemical used in the water works field. Available in simplex, duplex and triplex models. Bulletin SAN-7.

With %Proportioneers% Equipment you can always maintain precision control in water purification and sewage treatment. Ask us for recommendations and quotations. Our experience from over 27,000 installations is at your service.

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New Publications

Stream-Gaging Records. Stage and flow measurements made on the Mississippi River and its outlets and tributaries in 1946 have been compiled by the Mississippi River Commission and made available in a 332-page volume. Data for the gaging stations on streams, presented in the first part of the publication, consist of a description of the station, a tabulation of daily stages and where they were determined, and computed daily flows. The actual results of stream-flow observations comprise the second part of the volume. Copies are for sale at $1 each from the Office of the President of the Mississippi River Commission, Vicksburg, Miss.

Tennessee Valley Authority. Publication of Technical Report No. 10 on the planning, design, construction, and initial operations of the Douglas Dam and reservoir on the French Broad River in Tennessee is announced by the Tennessee Valley Authority. Although constructed on an emergency basis and operated primarily for power in the recent war, Douglas Dam forms an integral unit in the over-all system of water-control projects in the Tennessee Valley. Copies of the report, which contains 436 pages and 158 illustrations, may be purchased for $1.50 from the TVA Treasurer's Office at Knoxville, Tenn., or the Superintendent of Documents, Government Printing Office, Washington 25, D.C.

Sanitary Engineering. An extensive bibliography in the field of refuse collection and disposal for the years 1940–1948 has been prepared by Lee Weaver, of the Division of Sanitation of the U.S. Public Health Service. The first comprehensive compilation of its kind, the 66-page publication lists almost a thousand entries from United States and foreign professional journals and periodicals. Copies may be obtained without charge from the Surgeon General, Public Health Service, Washington 25, D.C.

Public Works. The far-flung public works program of the Federal Works Agency for the fiscal year ending June 30, 1948, is summarized in the Ninth Annual Report of the FWA. Copies of the 50-page illustrated report may be obtained from the FWA, Washington 25, D.C., without charge.

Flood Control. The Columbia Basin flood of 1948, which caused considerable loss of life and property damages estimated at more than $100,000,000, is described by the U.S. Geological Survey in Water-Supply Paper 1080. Included in the report are records of stage and discharge for the flood period at more than 200 stream-gaging stations, records of storage in many reservoirs, and a summary of peak discharges with comparative data for floods at nearly 500 measurement points. In a section entitled "Magnitude and Frequency of Floods in the Columbia River Basin," S. E. Rantz and H. C. Riggs, Jun. ASCE, discuss flood characteristics in the basin. The report is available at a cost of $1.25 from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.

(*Continued on page 82*)

Decrease in Construction Employment Is Reported

CONTRACT CONSTRUCTION EMPLOYMENT in mid-June totaled 2,081,000, according to preliminary estimates of the U.S. Bureau of Labor Statistics. Though this total represents an increase of 65,000 workers from the revised mid-May estimate, it is 92,000 under the number employed in June 1948. This decline over last year in the monthly rate of increase in construction activity is attributed partly to reduced activity in residential and non-residential building, which usually claim a large proportion of construction workers. This year, the Bureau states, between the February low and June, construction contractors added 261,000 employees; last year, in the same period, employment had risen by 442,000.

Most of the June 1949 rise in contract construction employment occurred in the west North Central and Middle Atlantic States. All regions of the country showed some rise, except the Pacific states, where a slight decline from mid-May was reported.

PRA Report Calls Interstate Highway System Vital

AN IMMEDIATE STEP-UP in construction of the Interstate Highway System is called vital to both peacetime and military needs in a special report prepared by the Public Roads Administration and recently submitted to Congress by PRA Commissioner Thomas H. MacDonald, Hon. M. ASCE. The interstate system consists of a network of highways serving 182 of the 199 cities with a population of 50,000 or more. It also connects the principal industrial areas throughout the country. Pointing out that these highways carry the bulk of the nation's traffic, the report emphasizes that "they should be among the first considered for improvement."

Though some sections of the system have been reconstructed since the war, large portions of it are described as "seriously obsolescent and not suitable, either in surface condition or in design, for the great number of vehicles attempting to use them." The present overcrowding of arterial routes is attributed to the fact that motor-vehicle traffic in the postwar years has increased faster than the rate of highway improvement. The interstate system, the report declares, is most deficient in sight distances and in the width of pavements, shoulders, and bridges.

The cost of eliminating such deficiencies and meeting present traffic requirements is estimated at more than $11 billion. An expenditure of over $500 million a year over a 20-year period is recommended in the report, which states, "No less provision can be economically justified."

To compensate for costs, sizable benefits are cited. Stating that "improvements would substantially increase traffic flows, speed movement, and increase safety," the report continues: "If in 1948 rural sections of the system had been improved as proposed, 1,400 lives lost in traffic accidents might have been saved. If in the same year the proposed improvement of urban sections had been completed, the saving of travel time alone, valued at a cent a minute, would have amounted to approximately four-fifths of an annual installment of the capital cost estimated, amortized over a period of 20 years."

Printed copies of the report will soon be available from the Superintendent of Documents, Government Printing Office, Washington, D.C.

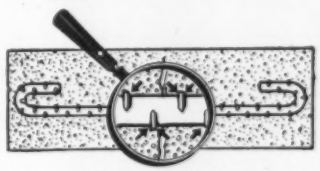
The Sixth of a Series in the interest of more efficient use of steel — a vital American resource

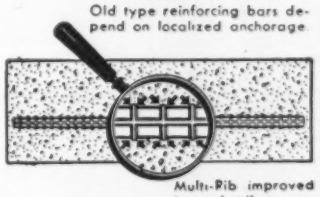
A VICTORY FOR BETTER USE OF STEEL IN CONSTRUCTION

Industry-wide acceptance of ASTM Specification A 305 deals a knock-out blow to waste in steel. Hooked ends are no longer recognized as an added anchorage factor with adequately deformed bars.

Laclede Multi-Rib Reinforcing Bars, which have contributed to the acceptance of ASTM 305 Specifications, *are rated at more than double* the bond strength of plain hooked bars. Bond values of 10% of the concrete strength are now permitted in reinforced concrete design.

Include these specifications in your construction and have all the advantages of strength, safety and steel conservation with Laclede Multi-Rib Bars.


Old type reinforcing bars depend on localized anchorage


Multi-Rib improved bars distribute anchorage and loads

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(Continued from page 80)

City Planning. To develop a better understanding of planning problems and encourage a broader participation in their solution, the Greater Boston Development Committee has issued a 287-page illustrated volume, entitled *Surging Cities*. Discussion of general urban planning problems and their solutions constitutes Part I of the study. Part II gives an up-to-date account of the particular problems of the Greater Boston region and of the plans and progress that have been made toward solution of the problems. Authors are Theodore T. McCrosky and Charles A. Blessing, Members ASCE, and J. Ross McKeever. The volume sells for $2.25 in paper binding and $3 in cloth, upon application to the Greater Boston Development Committee, Inc., 80 Federal Street, Boston, Mass.

Construction, India. Current engineering and construction developments in India are outlined in a weekly newsletter, recently started by the Government of India Information Service. Inquiries should be addressed to the Government of India, Information Services, 2107 Massachusetts Avenue, N.W., Washington 8, D.C.

Ports and Harbors. Recent publications of the Board of Engineers for Rivers and Harbors of the Corps of Engineers include a revised report on the Port of Corpus Christi, Tex., issued as No. 25 of the Port Series, and the 1949 edition of Miscellaneous Series No. 4, Port and Terminal Charges at United States Great Lakes Ports. No. 25 sells for 75 cents, and No. 4 for 35 cents, upon application to the Superintendent of Documents, Government Printing Office, Washington 25, D.C.

Philadelphia Improvements. A program of public improvements recommended by the Philadelphia City Planning Commission for the years 1949–1954 is outlined in an illustrated publication recently made available by the Commission. The present program (described in the March issue, page 62) calls for construction costs estimated at $257,305,800, a considerable reduction from the $322,793,000 total of the 1948–1953 program. Inquiries should be addressed to the Philadelphia City Planning Commission, Market Street National Bank Building, Philadelphia 7, Pa.

Structural Steel. An investigation of the flexural fatigue strength of steel beams, conducted by the Engineering Experiment Station at the University of Illinois, is reported by Wilbur M. Wilson, M. ASCE, research professor of structural engineering, in Engineering Experiment Station Bulletin Series No. 377. Agencies cooperating in the research were the Public Roads Administration, the Chicago Bridge & Iron Co., the Association of American Railroads, and the Bureau of Ships of the Navy Department. Copies of the bulletin may be purchased from the Engineering Experiment Station, University of Illinois, Urbana, Ill., at a cost of 20 cents each.

Traffic Control. Reprints of an article on the importance of effective law enforcement in the prevention of traffic accidents, entitled "Enforcement: Key to Safety," have been made available by the Accident Prevention Department of the Association of Casualty and Surety Companies. Copies of the article—written by J. Dewey Dorsett, general manager of the Association and reprinted from the *Casualty and Surety Journal*—may be obtained without charge from the Accident Prevention Department of the Association, 60 John Street, New York 7, N.Y.

Steel Research. Issuance of several new sections in the Steel Products Manual has been announced by the American Iron and Steel Institute (350 Fifth Avenue, New York 1, N.Y.), which sells copies at 25 cents each. These include Section 1 on "Pig Iron and Blast Furnace Ferroalloys"; Section 2, which treats "Semifinished Carbon Steel Products for Forging"; Section 8, entitled "Hot Rolled Carbon Steel Bars"; and Section 10 on "Hot Rolled Alloy Steels."

Hydraulic Research. Model investigations of problems involved in the improvement and maintenance of Savannah Harbor are detailed in Technical Memorandum No. 2-268, recently released by the Waterways Experiment Station. In describing the model techniques employed, the Army Corps of Engineers reports that this was the first tidal model in which liquids of different densities were used to represent ocean and river water, salt water being used in the model ocean and fresh water representing the river discharge. Inquiries regarding the two volume memorandum, which sells for $2 a set, should be addressed to the Waterways Experiment Station, Vicksburg, Miss.

Portable Dredge keeps two reservoirs free of silt!

The Corps of Engineers, U. S. Army, needed a portable dredge to remove accumulated silt from several reservoirs of the Washington Aqueduct water supply division which is an integral part of the Washington, D. C. water system. The operating machinery, consisting of the dredging ladder, dredging pump, hauling and hoisting machinery (designed and built by Ellicott for this 8-inch hydraulic dredge and placed on a hull of Navy wartime cubes) met the requirements of the U. S. Army Engineers to a "T".

The dredge is *portable* . . . can be easily disassembled for shipment by truck from one land-locked reservoir to another. And, *operation is clean* . . . electric operation keeps deleterious substances out of the water.

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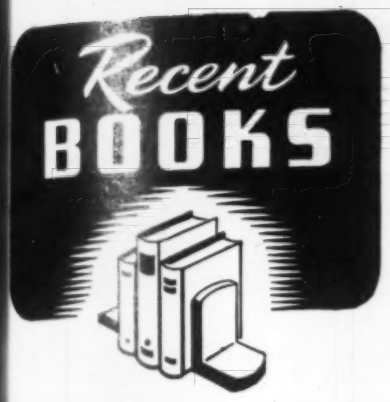

AMERICAN SOCIETY FOR TESTING MATERIALS, Proceedings, Vol. 48, 1948, Committee Reports and Technical Papers. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., 1949. 1354 pp., illus., diagrs., charts, tables, 9¼×6 in., cloth, $12. (ASTM members $8.) This annual volume contains all reports and papers offered to and accepted by the Society during the year indicated. The table of contents and the subject and author indexes cover all papers and reports published by the Society during the year including Special Technical Publications and material appearing in the ASTM Bulletin. Discussions accompany their respective papers, and a synopsis of each paper is provided.

AMERICAN UNIVERSITIES AND COLLEGES. 5 ed. Edited by A. J. Brumbaugh and M. Irwin. American Council on Education, Washington, D.C., 1948. 1054 pp., 9¾×6½ in., cloth, $8. Including the latest information, this book is an authoritative guide to accredited institutions of higher learning in the United States and its territories. In Part I, there are concise but comprehensive descriptions of various aspects of American higher education. Part II supplies pertinent information about 820 accredited institutions. In the appendixes, some further general and statistical data are given.

BASIC ENGINEERING SCIENCES, Solution to Problems, Part II, Professional Engineer Examinations, New York State. By W. Glendinning, 3123 Bell Boulevard, Bayside, New York, 1948. 60 pp., 11×8½ in., paper, $3. Useful to those preparing for Part II and Part III of the examinations for the License of Professional Engineer in New York State, this book presents questions and solutions to the problems of past examinations in practical application of basic engineering sciences. The major topics covered are hydraulics, mechanics and machine design, thermodynamics, and electrical principles and equipment.

CHAMBER'S SIX-FIGURE MATHEMATICAL TABLES. Vol. I. Logarithmic Values. Vol. II. Natural Values. By L. J. Comrie. D. Van Nostrand Co., Toronto, New York, London, 1949. 576 pp. each, tables, 10¼×7 in., cloth, $10 each ($17.50 per set). Vol. I of this set provides tables of logarithmic values as follows: Numbers up to 100,000 in various ranges and intervals; trigonometrical functions of angles in degrees, minutes and seconds; angle functions in degrees and decimals and in radians; hyperbolic and gamma functions. Vol. II provides tables of natural values for: Trigonometrical functions of angles in degrees, minutes and seconds; angle functions in degrees and decimals; circular functions (argument in radians); exponential and hyperbolic functions; also natural logarithms, powers, roots, reciprocals, factors, prime numbers, etc. Explanatory notes, conversion tables, physical and mathematical constants, and bibliographies of more extended tables appear in both volumes.

DER GRUNDBAU. Band I, Teil 1: Baugrund. 6 ed. By L. Brennecke and E. Lohmeyer. Verlag von Wilhelm Ernst & Sohn, 1948. 253 pp., illus., diagrs., charts, tables, 9½×6½ in., paper, 18 DM. Of interest to structural engineers, this book discusses in detail the properties and structure of soils under foundations. Types of soils are reviewed, and the structure of soil and the problem of water in soil are considered. The special problems arising due to cohesive and non-cohesive soils are presented in detail, and there is a full treatment of the soil requirements needed for good foundations.

DESIGN AND CONSTRUCTION OF REINFORCED CONCRETE BRIDGES. By A. W. Legat, G. Dunn, and W. A. Fairhurst. Concrete Publications Ltd., 14 Dartmouth St., London, S.W.1, Eng-

(Continued on page 84)

Positions Announced

New York State Civil Service Commission. Applications may be filed until August 12 for positions as Senior Building Construction Engineer, $5,232; Junior Civil Engineer, $3,450; and Mine and Tunnel Inspector, $3,174. For state jobs there are five annual salary increases, varying with base salary. Applications may be filed with the State Department of Civil Service at Albany, N.Y.; or Room 2301, 270 Broadway, New York City; or Room 302, State Office Building, Buffalo.

Washington State Department of Health. Applications will be accepted until further notice for positions as Public Health Engineer, at a monthly salary ranging from $310 to $380, and Senior Public Health Engineer, with a salary range from $360 to $450. Minimum qualifications for both include graduation from an accredited four-year college or university, with a major in civil or sanitary engineering, plus a year of graduate study in the major field. One year of experience may be substituted for the graduate study. In addition to educational requirements, the position of Senior Public Health Engineer requires three years of engineering experience. Information and application forms are available from the Washington State Department of Health or the Washington State Personnel Board, 1209 Smith Tower, Seattle 4, Wash.

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(Continued from page 83)

land, 1948. 515 pp., illus., diagrs., charts, tables, 9¼×6¼ in., cloth, 30s.; by post 31s. Of value to designers, contractors, and students, this book provides the theory, practical design, and modern methods of construction of reinforced concrete bridges of all types. Formulas, charts, tables, and data for the rapid preparation of complete calculations and estimates of cost are given. All stages of construction are fully illustrated. Numerous examples of actual structures and reproduction to a large scale of many working drawings are included.

FRANK AND LILLIAN GILBRETH, PARTNERS FOR LIFE. By E. Yost. Rutgers University Press, New Brunswick, N.J., and American Society of Mechanical Engineers, New York, 1949. 372 pp., illus., 8¼×5½ in., cloth, $5. Special discount to ASME and ASCE members of 20 per cent. In this combined biography, the early years of the two biographees are covered concurrently up to the time of their marriage. From that time on, the emphasis is on the partnership, both professional and domestic, which existed until the death of Frank Gilbreth. The methods of work and achievements of both are described during the period when they worked together, and the subsequent career of Lillian Gilbreth is carried on through the last three chapters.

HEATING VENTILATING AIR CONDITIONING GUIDE, Volume 27, 1949. American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York. 1,384 pp., illus., diagrs., charts, tables, 9¼×6¼in., cloth, $7.50. This standard manual constitutes both a textbook and handbook on the design and specification of heating, ventilating, and air conditioning systems. The technical data section is enlarged by some 80 pages owing to revisions and additions in accordance with current practice. The catalog data section has been increased by the addition of up-to-date products of many additional manufacturers.

MANAGEMENT PLANNING AND CONTROL. By B. H. Goetz. McGraw-Hill Book Co., New York, Toronto, London, 1949. 294 pp., charts, tables, 9¼×6 in., cloth, $3.75. This text develops a theory and practice of accounting from managerial needs for data to aid in solving problems of planning and controlling enterprise operations. The theory and technique presented are based on the use of incremental costs and revenues, and of opportunity costs. Practical examples of the application of the principles discussed are included, and a list of related reading material accompanies each chapter.

MITTEILUNGEN AUS DER VERSUCHSANSTALT FÜR WASSERBAU UND ERDBAU, NR. 14. Erdbaulicher Methoden zur Dimensionierung der Pisten beim Bau des Flughafens Kloten, by R. Haefeli and W. Schaad. Die Arbeiten der Erdbauabteilung der Versuchsanstalt für Wasserbau und Erdbau, by A. von Moos and R. Haefeli. Erdbaumechanik und Geologie, by A. von Moos and L. Bjerrum. Verlag Leemann, Zurich, Switzerland, 1946. 20 pp., illus., diagrs., charts, tables, 11¾×8 in., paper, 4 Swiss Frs. In No. 6 of the Contributions to the Hydraulic and Soil Testing Bureau of the Swiss Federal Technical Institute there are three papers: Soil mechanics methods used in dimensioning runways during the construction of the Kloten airport; the works of the soil mechanics division of the laboratory of the Hydraulic and Soil Mechanics Research Institute; and soil mechanics and geology.

ODORS, PHYSIOLOGY AND CONTROL. By C. J. McCord and W. N. Witheridge. McGraw-Hill Book Co., New York, London, Toronto, 1949. 405 pp., illus., diagrs., charts, tables, 9¼×6 in., cloth, $6.50. This book presents a comprehensive analysis of odor perception, measurement, classification, and regulation. It provides a valuable working knowledge of olfactory physiology and anatomy, the hedonics of odors, the relationship of odors to health, as well as the legal aspects of odor control. Emphasizing the varied applications, it outlines a number of practical methods to follow in eliminating odors from factories, homes, public buildings, and the person.

PRAKTISCHE STATIK, Einführung in die Statikberechnung der Tragwerke mit besonderer Rücksicht auf den Hoch- und Stahlbetonbau, 6 ed. By R. Saliger. Franz Deuticke, Vienna, Austria, 1949. 695 pp., diagrs., charts, tables, 10×6¾ in., paper, $9.; bound, $10. Now in its sixth edition, this detailed and comprehensive work deals with the statics of supporting structures with particular reference to high structures and reinforced concrete construction. The separate sections cover the theory of stress analysis, girders, arches and domes, rigid frames, and two-dimensional frameworks, etc. New material provides a treatment of the plastic theory of reinforced concrete and a discussion of earth-pressure effects.

(Continued from page 84)

PROFESSIONAL REGISTRATION LAWS AND THE ENGINEER. (A Study of Engineering Registration Laws.) By A. M. Sargent, author and publisher, 19669 John R St., Detroit 3, Michigan, 1948. 60 pp., illus., 8½×5½ in., paper, 75 cents. Of interest to the engineering profession, this pamphlet discusses engineering licensing laws in the various states, and their effects on engineers and engineering.

THE QUEST FOR PURE WATER, THE HISTORY OF WATER PURIFICATION from the Earliest Records to the Twentieth Century. By M. N. Baker. American Water Works Association, New York, 1948. 527 pp., illus., diagrs., 9¼×6 in., cloth, $5. This volume presents the practices used in water purification during the last 4,000 years. The development and usage of various filtration methods are traced. Sedimentation, coagulation, disinfection, distillation, and aeration are discussed. Problems of algae, softening, metallic ions, color, taste, and odor are considered, as well as medication by means of water supply. A 38-page, classified bibliography is included.

ROUTE SURVEYING. 3 ed. By G. W. Pickels and C. C. Wiley. John Wiley & Sons, New York; Chapman & Hall, London, 1949. 434 pp., illus., diagrs., charts, tables, 7×4½ in., cloth, $4.75. Beginning with a general discussion of survey work, the author proceeds to detailed explanations of maps, plans, profiles, distance considerations, grades, and curves. Separate chapters are devoted to the various types of curves and spirals, their calculation and layout, both for horizontal and vertical situations. Earthwork problems are dealt with at considerable length. In general, railroad surveys are treated first and in detail, with suggestions as to the application or modification of such methods to highways, canals, pipe, and lines, etc. The new edition has been considerably revised, particularly the chapter on string-lining.

SIMPLIFIED GRAPHICAL DISTRIBUTION OF MOMENTS IN RIGID FRAMES. By A. A. Eremin. The author, 1541 37th St., Sacramento 16, California. Diagrs., charts, tables, photo-offset, 11×8½ in., paper, $3. The method presented in this pamphlet is similar to that in the author's previous book on the "Analysis of Continuous Frames." Various improvements have, however, been made. The diagrams have been rearranged, and the graphical constructions have been classified by solving the numerical examples from practice.

STRENGTH OF MATERIALS. By C. O. Harris. American Technical Society, Chicago, Ill., 1949. 214 pp., illus., diagrs., charts, tables, 11×8 in., cloth, $4.90. Prepared not only for engineering students but also for others in industry who need such basic knowledge, this book presents a simplified discussion of the strength of materials. Each topic is developed in a step-by-step manner, and a set of practice problems follows each topic. Early chapters provide the needed background. The properties, advantages, and disadvantages of many materials are covered in detail. Topics receiving special attention include spot welding, fatigue in metals, and new materials which are currently being used in industry.

STRENGTH OF MATERIALS. By J. P. Den Hartog. McGraw-Hill Book Co., New York, Toronto, London, 1949. 323 pp., illus., diagrs., charts, tables, 9¼×6 in., cloth, $4. Designed for use in a first course on the subject, this book is a companion volume to the author's "Mechanics," and employs the same notations and sign conventions. Written in a descriptive style, each article starts with general theory and then presents the practical examples of the theory. There are 350 problems, complete with answers, at the end of the text.

STRUCTURAL DESIGN IN WOOD. By C. Mackintosh. School of Applied Engineering, 233 So. Broadway, Los Angeles, Calif., 1946. 100 pp., diagrs., charts, tables, 10¾×8½ in., paper, apply. This book contains a series of lectures on the effect of the special properties of timber upon the design of structures. Methods of designing structures together with their joints are considered with the object of obtaining maximum strength, safety, and durability. The woods dealt with are Douglas Fir, Redwood, and Southern Yellow Pine. Numerous diagrams, references, and questions are included.

WELDING METALLURGY. Iron and Steel. 2 ed. By O. H. Henry and G. E. Claussen and revised by G. E. Linnert. American Welding Society, 33 West 39th St., New York, 1949. 505 pp., illus., diagrs., charts, tables, 7¾×5¼ in., fabrikoid, $2.50. Intended for use by those in the welding industries, this book discusses the welding metallurgy of specific materials and the effect of different elements on the welding process. Over 150 pages have been added to this edition containing new information on recently introduced processes and more data on the metallurgy of specific materials. A short bibliography has been added to each chapter and an index to the book.

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EQUIPMENT, MATERIALS *and Methods*

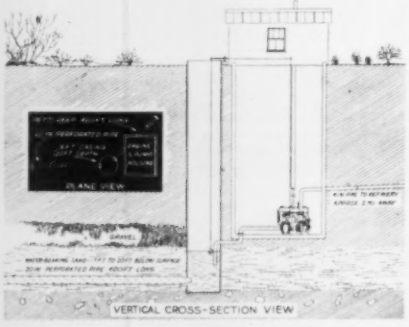
NEW DEVELOPMENTS OF INTEREST, AS REPORTED BY MANUFACTURERS

Dual Valve

THE DEVELOPMENT OF a 36 in. by 8 in. 150 lb class B steel dual valve for an operating temperature of 1000°F has been announced. Body casting is chrome-molly steel. Powered by separate electric motors, each alloy steel vane is operated independently of the other insuring close control of volume and pressure. Designated as valve No. 725, it is designed for either a high pressure drop and small volume or a low pressure drop and large volume, thus operating beyond the limitations of a single valve. Available in all materials, in various combinations of sizes and for higher pressures. **R-S Products Corp., Wayne Junction, Philadelphia 44, Pa.**

New Pumping Method

AN INGENIOUS METHOD of obtaining a large quantity of water from seeping sand has been developed at a refinery where a "horizontal" well has drawn 2,500 barrels a day from a 3 ft sand formation since 1944. The plant was threatened with closing because the city was unable to supply enough water to meet its requirements. Another source had to be established quickly. The well was sunk, and water transferred from there to the refinery through 2 miles of 4 in. pipe by an International U-2 engine on a centrifugal pump. Principal feature of this method is the use of two 400 ft lengths of 20 in. pipe, imbedded in the water sand 18 ft beneath the surface. Quarter-inch slots in each pipe, staggered around the

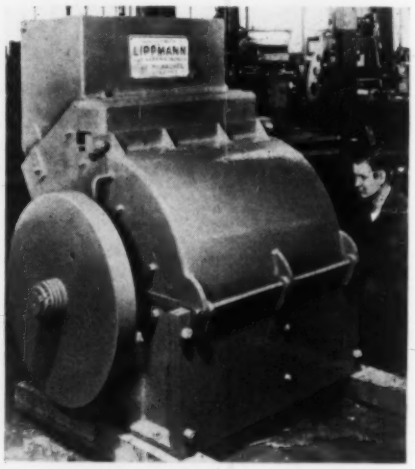


Section of "Horizontal" Well

circumference and down the length, permit water to seep in from the sand. Water drains from the gathering pipes into a casing 5 ft in dia and 20 ft deep. It is pumped from there to an open tank at the refinery, where it is used in boiler feed circulating pumps. A shaft sunk beside the casing, houses the U-2 engine and the pump. Operating 24 hr a day, the engine maintains a flow of 50–60 gal per min, under pressures ranging from 60 to 100 lb. **Industrial Power Div., International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill.**

Pulverizer

A 32 x 36 IN. PULVERIZER embodying such engineered features as non-choke steep angle feed chute, expanding crushing chamber, spider type congestion relieving rotor, forged hammer arms, four-edge wear abrasion resisting steel grate bars,



Pulverizer Featuring Non-Choke Feed Chute

one piece four-edge wear hammers, and manganese and abrasion resisting steel armored wearing surfaces has been manufactured. In addition an extraordinarily large feed opening permits the entrance of extremely large rocks for primary reduction purposes. The grate bars can be removed quickly and simply for production of road aggregate. 98 to 100% of this machine's entire capacity will pass minus 8 mesh screen, which is the particular size specification required by the government for most efficient agricultural limestone. For further information write for bulletin 1160. **Lippmann Engineering Works, Milwaukee, Wis.**

Hydraulic Pump Units

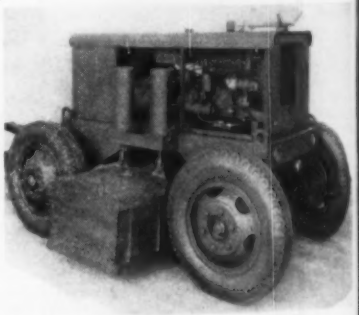
HYDRAULIC PUMP UNITS for operation of forged-track dump trailers are now adaptable to all makes of track-type tractors. This will enable tractor owners to equip their machines with the Athey hydraulic units, especially designed for use with Athey track-type earth and rock-moving trailers. The pump unit provides smooth, positive control of dumping operations, allowing the trailers to be side-dumped with a high degree of accuracy, either when stationary or while tractor and trailer are moving. The pump, tank and valve unit is built for heavy-duty and long life, requiring a minimum of attention and maintenance. Controls for the hydraulic system are located near the tractor operator, ready for instant spotting of loads. **Athey Products Corp., 5631 W. 65 St., Chicago 38, Ill.**

Diaphragm Pump

THE REX 4 IN. CLOSED diaphragm pump has a capacity rated at 6,000 gal per hr with a 10 ft suction lift. This pump is of all welded steel construction using yolloy steel for rust and abrasion resistance and lighter weight. The Rex diaphragm weighs only 440 lb. No castings are used, thus giving greater strength and lighter weight. All enclosed gear case high helicoid type, cut gears mounted on ball bearings running in oil for smooth operation and long-life-low maintenance. The crank arm of the diaphragm has needle bearings and a shear pin. This shear pin is a safety measure protecting the gears and power unit in case of abnormal overloads or severe clogging. **Chain Belt Co., 1600 W. Bruce St., Milwaukee 4, Wis.**

Magnetic Sweeper

AN ELECTRO-MAGNET SWEEPER, powered by a gasoline engine generator set with self-contained switchboard, both mounted on a 4-wheel trailer, has recently been developed. These sweeper units are designed specifically for magnetically sweeping airport landing strips, roads, etc. of metal waste which might cause serious accidents to planes or other equipment. Briefly, the unit consists of a 4-cylinder, gasoline engine driving a



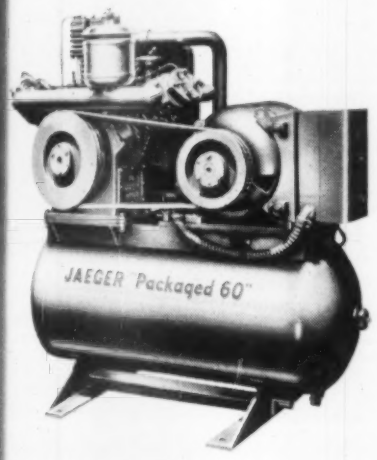
Trailer-Mounted Sweeper

7½ kw direct current generator, which furnishes the electric power to energize the magnet pick-up unit. The trailer assembly is of sturdy construction to support the weight of the engine generator set and the magnet under adverse road conditions, and is equipped with heavy-duty tires and a steel angle drawbar for attaching to truck or tractor. Specifications and photographs furnished upon request. **International Diesel Electric Co., Inc., 13-02 44 Ave., Long Island City 1, N.Y.**

Equipment, Materials & Methods (Continued)

Heavy-Duty Compressor

THE "PACKAGED 60" stationary compressor, a complete and ready-to-operate airpower plant, for those who want the heavy-duty dependability of larger compressors in a 60 cfm unit has been announced. The compressor consists of 2-stage, v-belt-driven, air-cooled compressor and 15 hp electric motor mounted on an 8.5 cu ft air receiver with base, and all electrical controls. Being air cooled,



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water supply is no problem. Force-feed lubrication, scientifically finned cylinders, large streamlined air passages, oversize valves, and efficient cooling of air between compression stages are all features which contribute to its dependable, low-cost delivery of 60 cu ft of 100 lb air per min at moderate temperature. Maximum working pressure is 125 lb. **The Jaeger Machine Co., Columbus 16, Ohio.**

Diesel Engines

THE MODEL 1-FFD 34-TON tandem axle rear-dump Euclid is powered by two 190 hp General Motors diesel engine-torque converter units each driving one rear axle which eliminates the conventional inter-axle power divider. A three speed torq-matic transmission does away with clutch pedal or manual shifting of gears. Operator can change to proper gear under full power and at any travel speed. Due to their symmetrical cylinder blocks, the GM series 71 diesel engines may be assembled with blowers and accessories on either right or left-hand side. Long a feature of GM diesel engines in "Twin 6" arrangement or as "matched pairs" for twin screw marine propulsion, this is the first time two of these engines have been so mounted for this type of truck applica-

(Continued on page 88)

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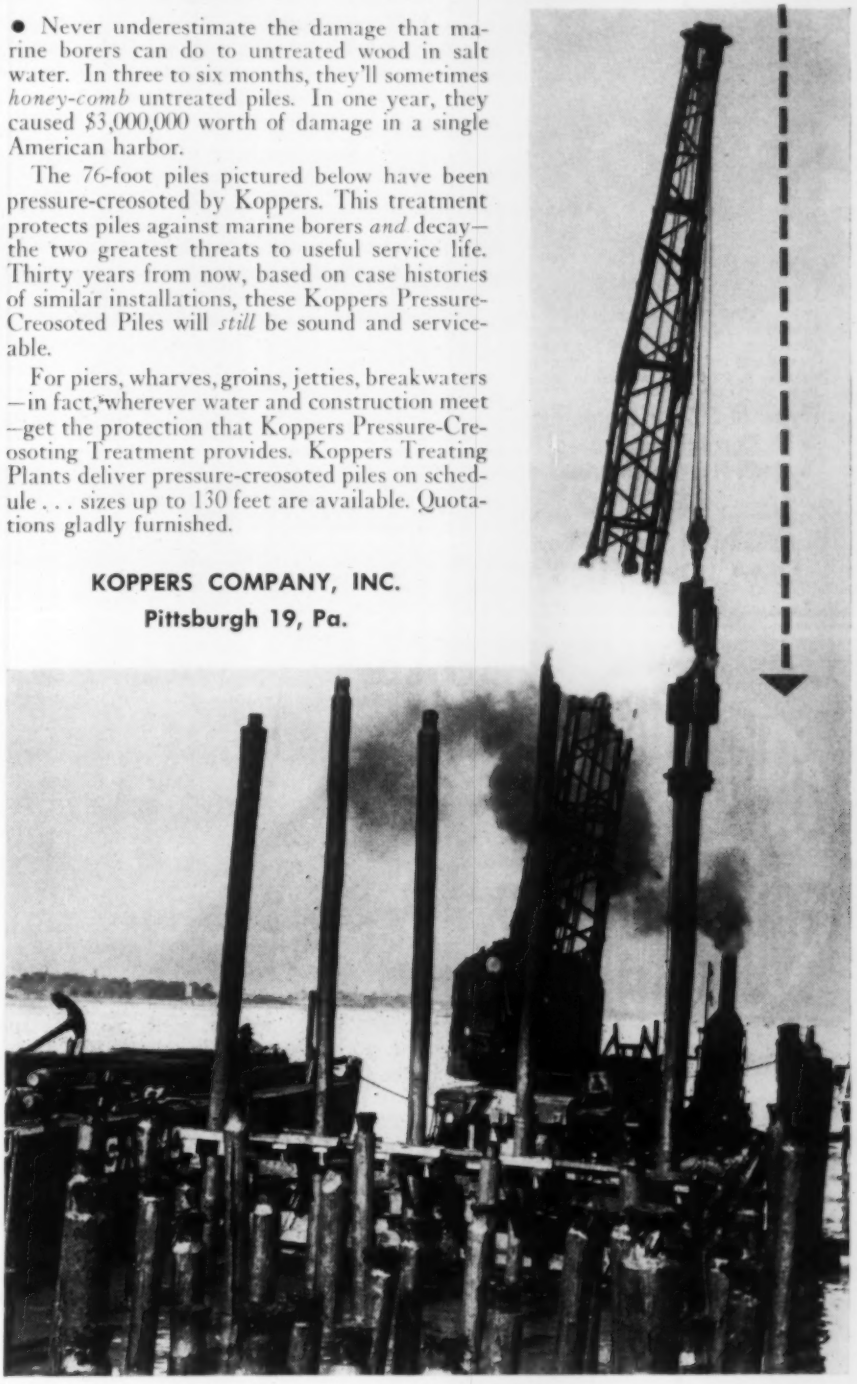

Foundation piles being driven for the 150-foot extension of the U. S. Coast Guard pier at Charleston, S. C.

KOPPERS PRESSURE-TREATED WOOD

TIDE GATES

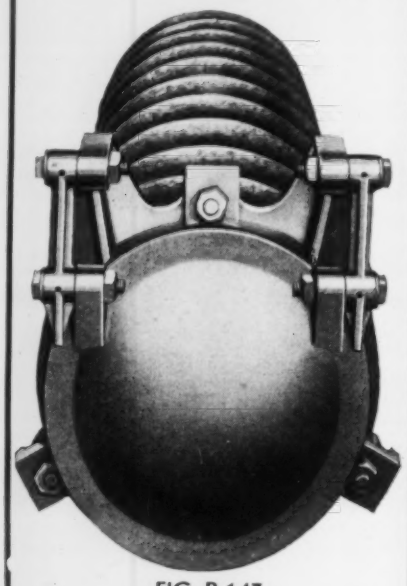

FIG. B-147

Type M-5 Tide Gates for use with Corrugated Culvert Pipe. Bulletin No. 91 describes them fully.

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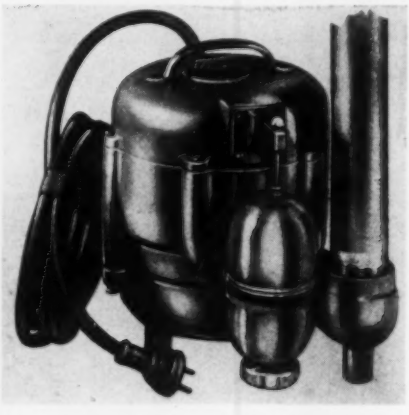
Equipment, Materials & Methods (Continued)

tion. The mamouth hauling unit was designed for mining and construction jobs where large tonnage must be moved in off-the-highway service. Hydraulic booster steering and steering brakes on the drive wheels make the big "Euc" easy to steer and easy to handle in close quarters or on difficult haul roads. **Detroit Diesel Engine Div., General Motors Corp., 13400 W. Outer Drive, Detroit 28, Mich.**

Submersible Utility Pump

THE "ENPO" SUBMERSIBLE utility pump was designed to run under water and eliminate the possibility of pumps becoming inoperative due to flooding out. The 1/4 hp, single phase, 115 volt, 60 cycle motor is hermetically sealed and is constructed of non-corrosive materials. The pump is produced with either manual or automatic float control. It is the centrifugal type and delivers 3,000 gal per hr.



Pump Produced with Either Manual or Automatic Float Control

The pump is non-clogging, life-time lubricated, light weight, easily portable and features quiet operation and non-corrosive construction throughout. Literature is available and will be gladly furnished. **Piqua Machine & Mfg. Co., Piqua, Ohio.**

Truck-Mounted Hydrocrane

BY USING A FAST, truck-mounted hydrocrane, the Milwaukee Sewer Dept. has speeded digging of storm inlet overflows and catch basin trenches. They dig over 600 of these trenches each year and have reduced costs about 30% by switching from hand labor to the hydrocrane. In addition to its regular digging work, the hydrocrane speeds to emergency jobs in a few min—hand crews with shelter wagons often took from 2 to 3 hr. Although the

(*Continued on page 89*)

To Save Even One Life-
Who'd Count The Cost?
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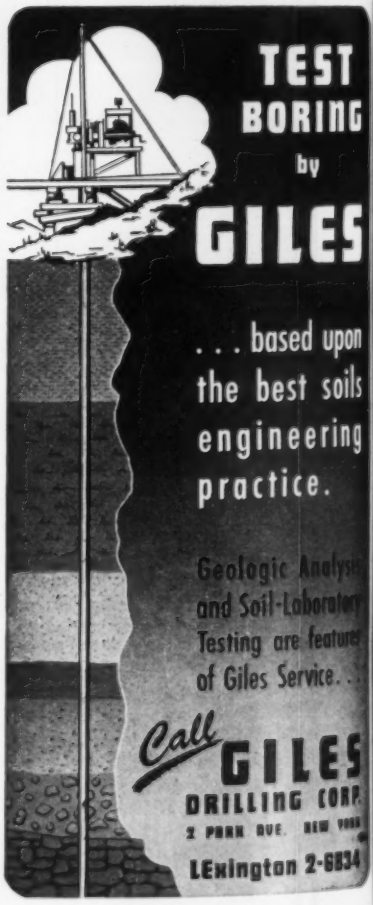

What's to be Said About Durability

Durability in a well water system is something that doesn't just happen.

It has to be built-in from carefully made plans, extra good materials and a lot of know how.

With nearly seventy years of experience in designing, building, testing, installing, servicing—and repairing well water systems, it seems quite logical that Layne might know something about what it takes to create durability.

Layne does! And that's a very emphatic statement backed up by actual operating facts on hundreds of systems, many of which according to their tremendous production records, should have been worn out years ago, but are still humming along at remarkably high efficiency.

Absolute perfection in any kind of mechanical equipment has never been achieved, but Layne can assure every buyer that their systems are definitely unmatched in long life durability,—a fact that probably accounts for their extraordinarily wide use.

For further information, catalogs, etc., address Layne & Bowler, Inc., General Offices, Memphis 8, Tenn.

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department uses the machine principally for digging, the hydrocrane also sets sewer pipe and places valves and pipe fittings on water mains. With a special bucket, it can clean catch basins quickly and thoroughly. Because of its telescoping boom, this fully hydraulic crane can work in extremely close quarters, under overhanging wires and branches. The machine is controlled entirely by hand levers and is very simple to operate. Hydrocranes are built in two models—1/4 yd, 2 ton and 3/8 yd, and 3 ton. **Bucyrus-Erie Co., S. Milwaukee, Wis.**

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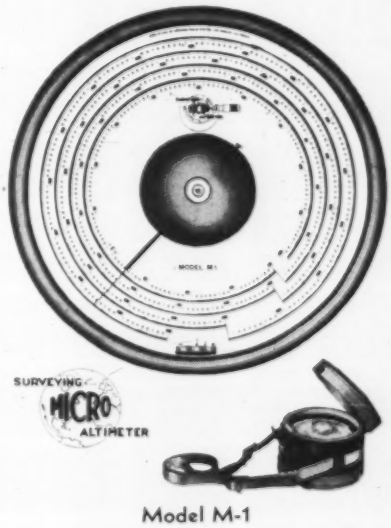
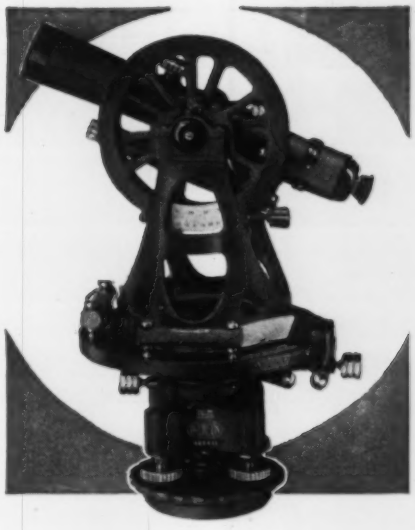
A NEW MICRO-ALTIMETER, known as Model M-1, is the first of a new micro series available. Graduated in intervals of one ft over a range of 6,000 ft, this remarkable instrument is accurate to one ft and sensitive to altitude changes in inches. Geologists, surveyors and field



Model M-1

engineers can now run surveys with this easily portable instrument (weighs only 4 1/2 lb) in 1/10 the time consumed in ordinary surveys and with an accuracy and dependability hitherto unknown in this type of instrument work. Model M-1 will shortly be supplemented by Model M-5 with a range of 15,000 ft graduated in intervals of 5 ft and also Model MM-1 with a range of 5,000 meters graduated in intervals of one meter. All models are encased in a beautiful and rugged leather carrying case with hand and shoulder straps. Included with each instrument is magnifier, thermometer and full operational procedures. **American Paulin System, Los Angeles, Calif.**



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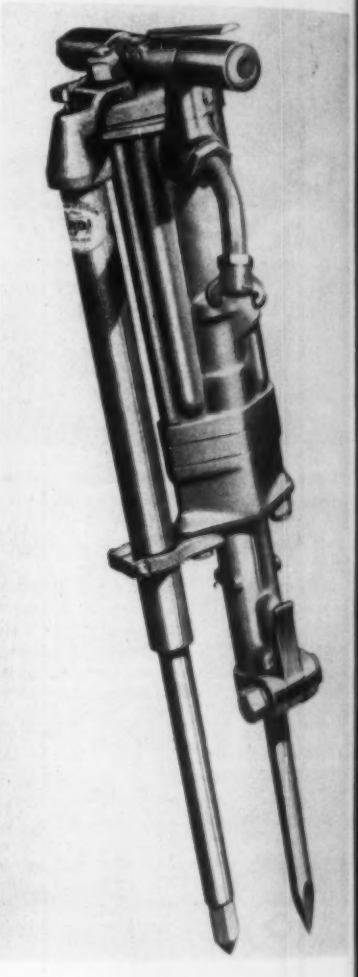

The 52AJ Air-Jac

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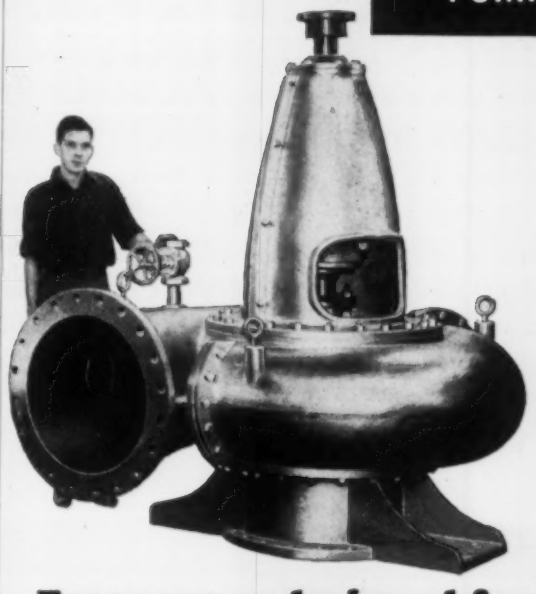

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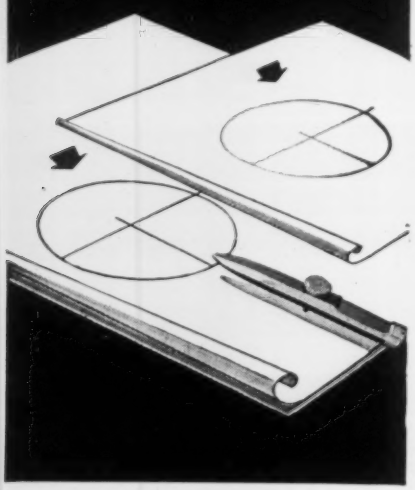

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MOTOR GRADERS—A 16-page booklet entitled "'Cat' Motor Graders Do The Job," designated as Form 12258, has been released. Illustrated with applications of precision ditching, bank shaping, general road maintenance, mixing road surfaces, terracing and snow removal, this publication offers performance records on coast-to-coast projects by these units. **Caterpillar Tractor Co., Peoria 8, Ill.**

DECK BRIDGES—An illustrated booklet gives detailed information on composite deck bridges for endurance and economy. Shows installation of factory-fabricated timber and concrete bridge deck. Erection techniques, pressure treatment of timber members and elimination of formwork and shoring. Details of timber deck grooves, daps, scupper blocks, felloe guards and guard rails are included. **Timber Structures, Inc., Box 3782-(CC), Portland 8, Ore.**

WATER FLOW MEASUREMENTS—A handy pocket sized booklet entitled, "Measurement of Water Flow Through Pipe Orifice with Free Discharge," has been revised and reissued. Forty fact-crammed pages explain the Layne pipe orifice meter method of computing water flow. It tells how to use it, how accurate it is, gives flow graphs for various size pipes, and explains the method of computation. **Layne & Bowler, Inc., P. O. Box 215, Hollywood Station, Memphis 8, Tenn.**

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